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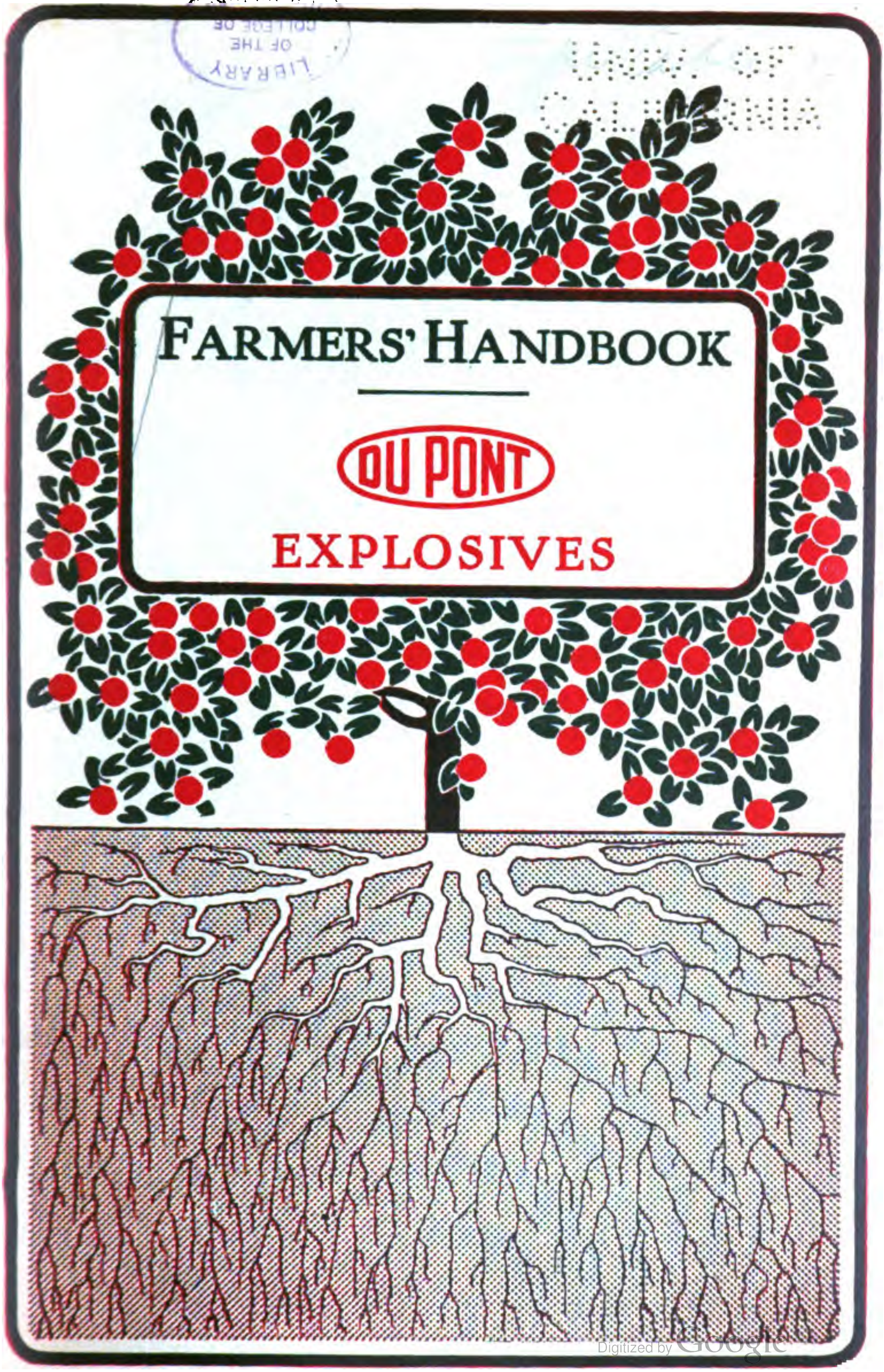

FARMERS' HANDBOOK

DU PONT

EXPLOSIVES

A-348

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Wilmington, Del.

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Du Pont Publications.

1. Farmers' Handbook of Explosives. 1915.
2. Farmers' Handbook. How to use Red Cross dynamite.
3. New farms for old.
4. Agricultural blasting. A money-making profession.
5. Increasing orchard profits with DuPont red cross farm powder.
6. High explosives. Second section. Kinds, grades, and brands. 1915
7. Blasting pole and post holes. A quick, economical method.
8. Explosives for quarry blasting.
9. Developing logged-off lands of the northwest with DuPont explosives.
10. Sub-soiling with Bynamite.
11. Farmers' Bulletin. No. 1. Agricultural promotion work.I. The breath of life or underground air.
12. Farmers' Bulletin 2. Agricultural promotion work.I. New method of removing alkali from irrigated lands.
13. Farmers' Bulletin 3. Agricultural promotion work. High explosives a factor in the reclamation of wet lands.
14. Tree planting with red cross dynamite.
15. Drainage with red cross dynamite.
16. Uses of DuPont and Repauno stumpin powder.
17. Squrrels and Gophers absolutley exterminated.
18. A few pointers on charging and tamping bore holes.

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DU PONT

FARMERS' HANDBOOK

INSTRUCTIONS
IN THE USE OF
HIGH EXPLOSIVES

for

CLEARING LAND, PLANTING
AND CULTIVATING TREES
DRAINAGE, DITCHING
AND SUBSOILING

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E. I. DU PONT DE NEMOURS POWDER CO.
Established 1802
WILMINGTON, DELAWARE

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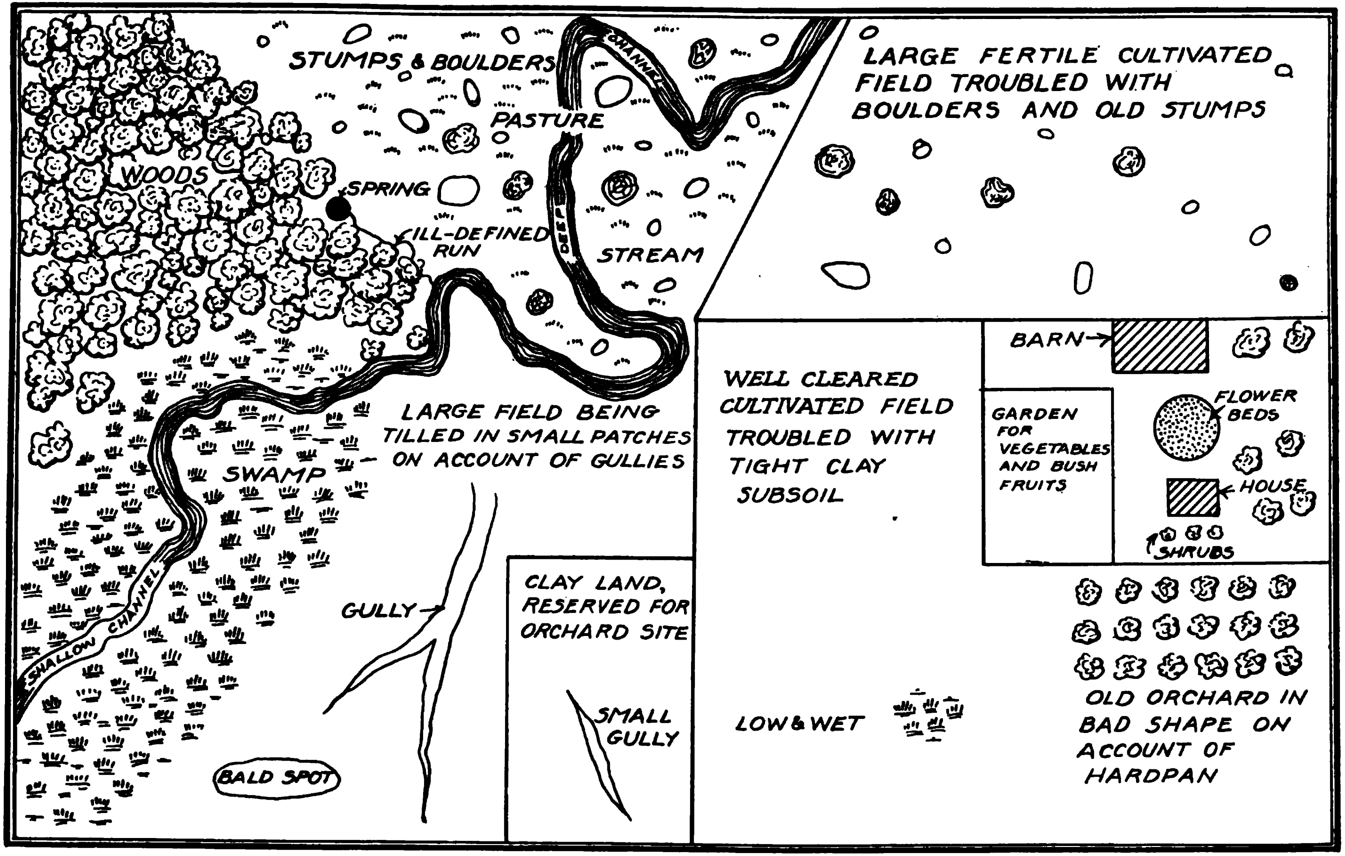
STUMPS & BOULDERS
PASTURE
CHANNEL
LARGE FERTILE CULTIVATED FIELD TROUBLED WITH BOULDERS AND OLD STUMPS
WOODS
SPRING
ILL-DEFINED RUN
DEEP
STREAM
BARN
GARDEN FOR VEGETABLES AND BUSH FRUITS
FLOWER BEDS
HOUSE
SHRUBS
WELL CLEARED CULTIVATED FIELD TROUBLED WITH TIGHT CLAY SUBSOIL
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OLD ORCHARD IN BAD SHAPE ON ACCOUNT OF HARDPAN
SHALLOW CHANNEL
BALD SPOT

THE UNDERSIZED FARM, SHOWING HOW THE PRODUCTIVE AREA IS REDUCED BY DEFECTS THAT BLASTING WILL REMEDY

Purpose of This Book

THIS book is intended to point out the advantages of the use of explosives for various purposes on the farm, and to give instructions for their use.

This first part is to emphasize the different purposes for which explosives may be used, and the technical supplement is to describe the most approved methods of blasting.

The Full-Sized Farm

Every possible acre of the farm should be used to its maximum capacity. The farms of the United States now fall so far short of this ideal that the profitable production of crops is seriously curtailed. To offset the 478,451,750 acres of improved land on our farms, we have 400,346,575 acres of unimproved land. Disregarding all land too rocky or steep to be improved a careful study reveals the fact that the average farm has from 1 to 30 acres out of every hundred acres that is suitable for improvement but which is now allowed to lie waste. The figures showing that the total acreage of waste land presents a national problem, but the few acres on the farm of the individual farmer is a personal matter needing immediate attention.

The cost of improving is usually low, and expenditures for this purpose are permanent investments that will be returned, many times over, in profitable crops.

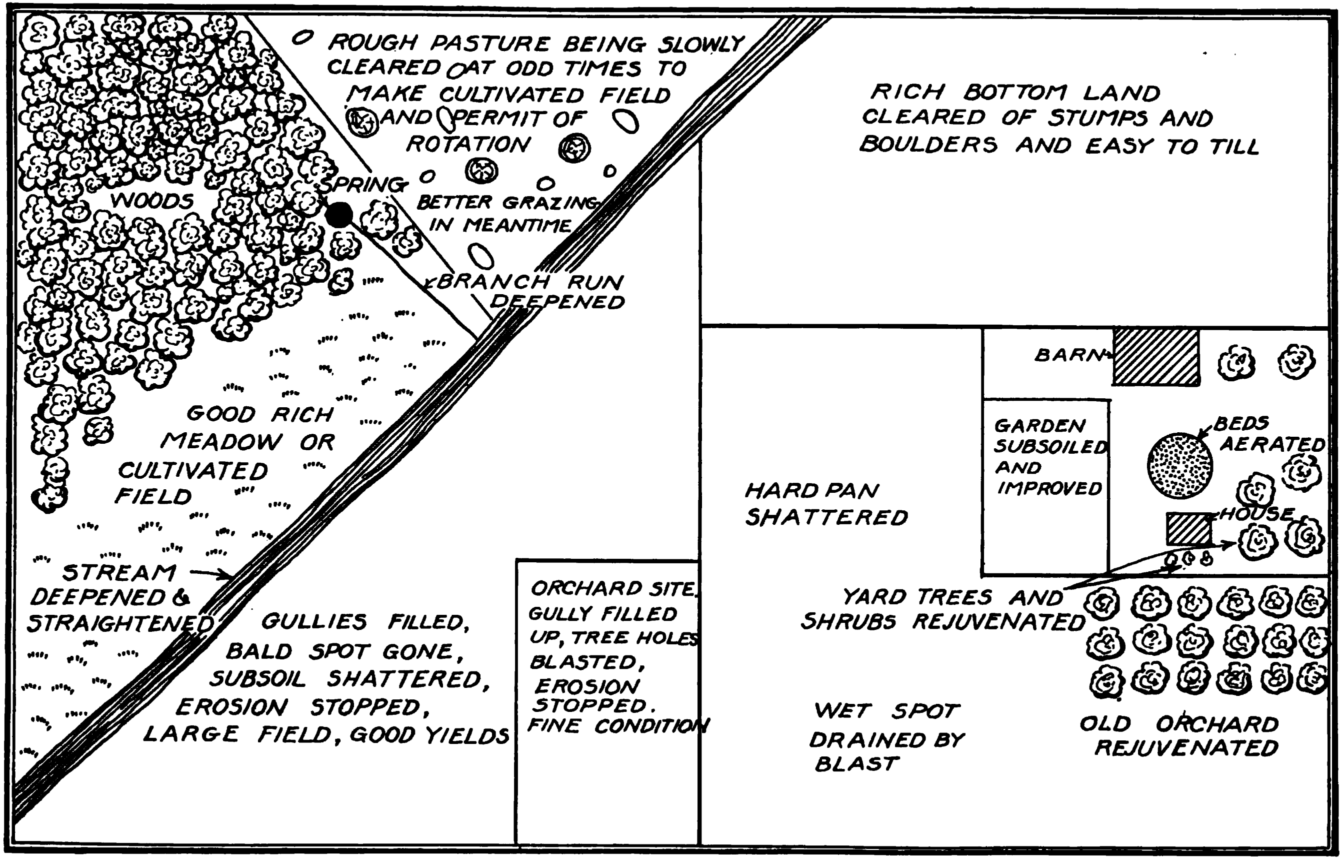
The causes of waste land usually are: stumps, boulders, wet spots, gullies and hardpan. The two accompanying maps are to show how one or all of these troubles may reduce the workable size of the farm, and the farm after being made full size.

Stumps cause "Loafer Land" by taking up space in the fields, by prohibiting economical cultivation, by making breeding places for weeds and crop pests, and make the farm unsightly. Our map shows them encumbering the most fertile field on the farm, and preventing the bringing of the back pasture into the much needed rotation.

Boulders offer the same general troubles as stumps and are shown assisting the stumps in dwarfing our farm.

The overflow caused by the shallow, crooked stream channel takes away more good land and replaces it with a swamp that breeds disease and does not even afford good pasture. The spring and its shallow outlet make this condition still worse.

A part of the back fields are gullied and cut up into small patches that cannot be handled successfully. The fertile surface has been washed away. The bald or galled spots will not produce because there can be no storage of moisture and no humus.


ROUGH PASTURE BEING SLOWLY CLEARED AT ODD TIMES TO MAKE CULTIVATED FIELD AND PERMIT OF ROTATION
RICH BOTTOM LAND CLEARED OF STUMPS AND BOULDERS AND EASY TO TILL
WOODS
SPRING
BETTER GRAZING IN MEANTIME
BRANCH RUN DEEPENED
BARN
GOOD RICH MEADOW OR CULTIVATED FIELD
GARDEN SUBSOILED AND IMPROVED
BEDS AERATED
HARD PAN SHATTERED
HOUSE
STREAM DEEPENED & STRAIGHTENED
ORCHARD SITE, GULLY FILLED UP, TREE HOLES BLASTED, EROSION STOPPED. FINE CONDITION
YARD TREES AND SHRUBS REJUVENATED
GULLIES FILLED, BALD SPOT GONE, SUBSOIL SHATTERED, EROSION STOPPED, LARGE FIELD, GOOD YIELDS
WET SPOT DRAINED BY BLAST
OLD ORCHARD REJUVENATED

THE FULL-SIZED FARM, GIVING A FULL AREA OF PRODUCTIVE LAND AFTER IT HAS BEEN PROPERLY IMPROVED WITH DU PONT EXPLOSIVES

The tight clay cuts off the under side of the farm and is always effective in reducing the productive size of the farm by taking from it the third dimension—depth. It reduces yields of field crops and kills or stunts the trees.

The wet spot back of the house is a constant source of loss and worry.

The trees, flowers and garden cannot flourish over the hardpan.

Our farm looks bad. It is not full sized, being only one-third efficient in crop production. It is typical in one feature or another of practically every farm.

The Transformation

The desire is for the use of all the land, large fields, good crops, a good orchard, a bounteous garden and an attractive house.

In changing this abject proposition to a full-sized farm we naturally want to begin on the easiest places.

The otherwise good bottom has but to be rid of stumps to make it conform to the highest ideals of the owner. These stumps are old and dead, and but small charges of explosives are required to dispose of them.

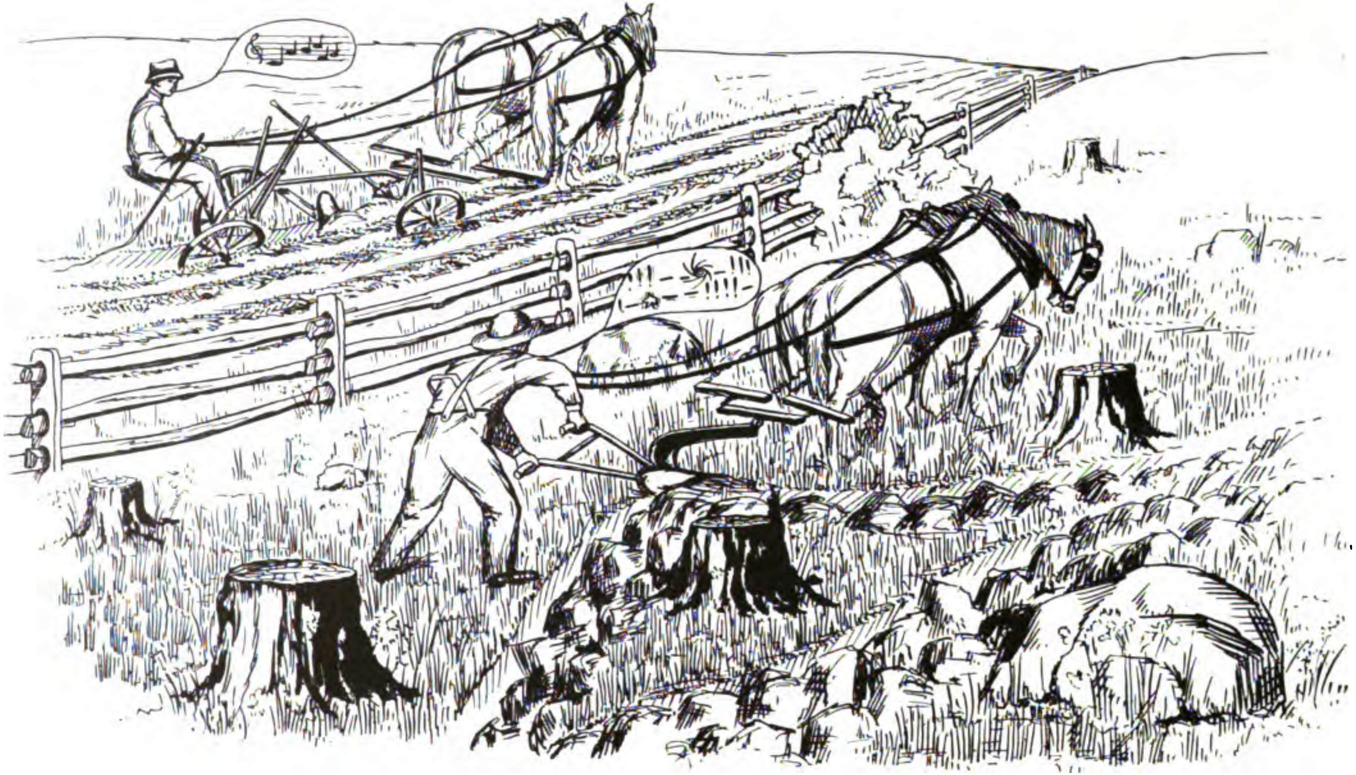
The gullies and bare spots in the big field follow next, as a line of lightly loaded charges will tumble the gullies so near full of soil that they can be plowed across and brought into actual cultivation. Subsoil shattering and a coating of manure will revive the bald spots and the rest of the hardpan and the field is all ready for the green manure crop to fit it for a fruitful orchard and good staple crops.

With these two big fields in good condition attention is turned to drainage and the water from the wet spot back of the house disappears through crevices blasted into underlying ground. A blast from a long line of loaded holes makes a fine straight channel for the creek and a line of lighter loads lowers the spring branch so that all of the fertile swamp becomes field or meadow.

Spare hours spent in blasting the yard, garden and old orchard enlivens flowers, trees and vegetables, and lays the foundation for future good years for each of them.

When all else is done the rough old pasture can be attacked as occasion affords. When the stumps and boulders are all gone the once unsightly spot can be brought into the regular rotation.

Through the mystic medium of the little harmless looking cartridge, the Lazy Loafer Farm has been transformed into a neat, cozy, profitable one; the full size and use attained.



WHICH IS YOUR PICTURE?

Clearing Land

Land that is to be farmed should be cleared of stumps and boulders. The picture on the opposite page tells its own story of the advantages of smooth fields and the disadvantages of trying to farm stump land.

The picture was suggested to our artist by a letter from a Mr. Marriott, an Illinois farmer, as follows:

> "Well, yours truly can now sit on a riding cultivator and cultivate ten acres a day, while just over the fence is a poor old-timer dodging stumps and cussing loud and long while tilling (or trying to) about four acres a day, and where there is a stump he loses from eight to fourteen hills of corn."

An enterprising West Virginia farmer has given the question of stump clearing very careful attention. He has figured it out that an average square foot of his land would produce at least one cent's worth of crop; that the average stump takes up 25 square feet. Thus every stump in a cultivated field costs the farmer from 25c. to 50c. a year. Not only that, but the stumps are breeding places for vermin and every stump will have a lot of undesirable weeds growing around it, the seeds from which spread over adjoining land and mix weeds with the crops.

If this farmer's arguments are sound, the farmer who permits a stump to remain in a cultivated field loses as much or nearly as much every year as the explosives would cost with which to remove it. If he allows the stump to remain five years, he loses five times as much as it would cost to remove it. Can any farmer who conducts his farming operations in this way claim to be a good business man? Can he expect to be successful as a farmer? Can he expect ever to become wealthy at the business?

Again, suppose a farmer should want to sell his farm. The appearance and condition of it would have much to do with what it would bring. If stumps are seen in the fields used for cropping, the prospective purchaser at once forms a bad impression of the place and, if he offers to buy at all, fixes his bid according to his view. Many a farm has been sold at a price much higher than surrounding places would have brought, not because they are better farms or would produce larger crops, but simply because they presented a neater, cleaner appearance.

Clearing Doubles Value of Land

Have blasted with Red Cross 40 stumps, from one and a half to three feet, at a cost of 35 cents per stump or $24 per acre, while any other method would have cost at least $2.00 per stump or $100 to $160 an acre. After blowing these stumps with Red Cross the value of the land was doubled. Will remove 35 more stumps later on and will surely use Red Cross.

BEN J. RODENBERG,
Howell, Ind.

Grubbing Hard and Slow Work

Grubbing out stumps is about as hard work as any man wants to tackle. Then, too, it is so slow a process that a farmer cannot hope to get acreage of any size cleared in years, unless he hires help, and that costs more than explosives because progress is so slow.

WASTE LAND NEAR HIBBING, MINN. FARM OF G. G. HARTLEY

SAME LAND WITH STUMPS BLASTED

SAME LAND 10 MONTHS AFTER BLASTING, YIELDING $800 WORTH OF CELERY PER ACRE

Vermin Leaves Cleared Land

I cleared three acres of stump land with Red Cross—had tried to farm around the stumps for three years, but could never get a good stand of corn because of moles that made their headquarters near the stumps. I never saw a mole after I removed the stumps and have been getting a fine stand of corn and good crops ever since.

DANIEL STAKER,
Pekin, Ill.

Red Cross Cheaper Than a Donkey Engine

I moved about forty fir and cedar stumps with Red Cross. The work cost me about $1 per stump or a total of $40. The stumps ranged from one and a half to three feet in diameter, and would have cost $2.50 per stump or a total of $100 to take out by any other method.

There was a donkey engine working on my neighbor's place, but I beat it with Red Cross.

BURT P. WISE,
Carrolton, Wash.

Subsoils and Clears at Same Time

A fact seldom considered by farmers is that using explosives for blasting out stumps improves the mechanical condition of the soil by breaking up the hard subsoils and bettering the drainage. If big crops are the object aimed at, these are very important considerations.

Blasting Clears and Improves Land

I had a great many lightwood stumps on my farm near here and some of them had been burned off level with the ground and were awfully mean about breaking plows and jerking the mules. I suppose I had about 400 stumps on about fifty acres and it cost me too much to dig them up by hand. In fact, some of them were so large and so hard to get at that I could not get it done. I tried a little of your Red Cross and was so pleased that I had every stump blown out. The lightwood I got will last me for ten years and is worth more than the cost of the explosive.

One part of my land was low and wet and hard to get a stand on. On this piece of land there were a great many stumps. After they were removed I made my best corn on the spot where they had stood. I now strongly advocate the use of Red Cross for removing stumps. It not only gets the stumps out, but greatly improves the land.

It cost me about $80.00 to stump my place, but I would not have the stumps back in the fields for $500.00 or more.

W. A. BLIZZARD,
Dillon, S. C.

Red Cross Removes 10,000 Stumps; Trebles Land Value

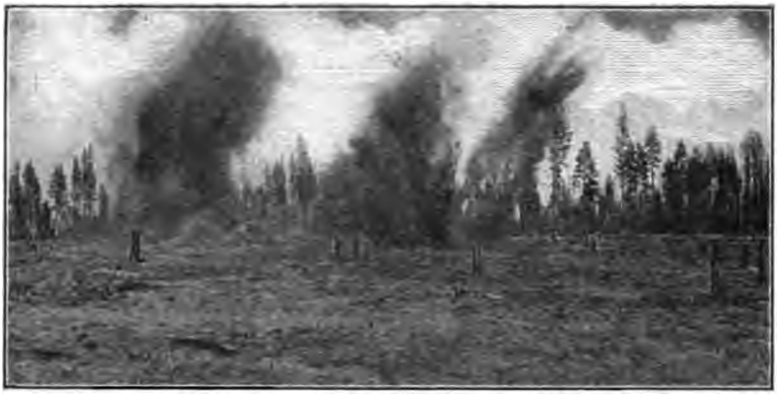
During the last four years I have blasted about 10,000 pine, poplar, elm, oak and spruce stumps, ranging from 10 inches to 4 feet in size, on all of which Red Cross was used.

I cleared about 100 acres at a cost of about 9½ cents per stump, or $10 per acre, and feel very certain that by any other method this work would have cost at least 25 cents per stump or $25 per acre.

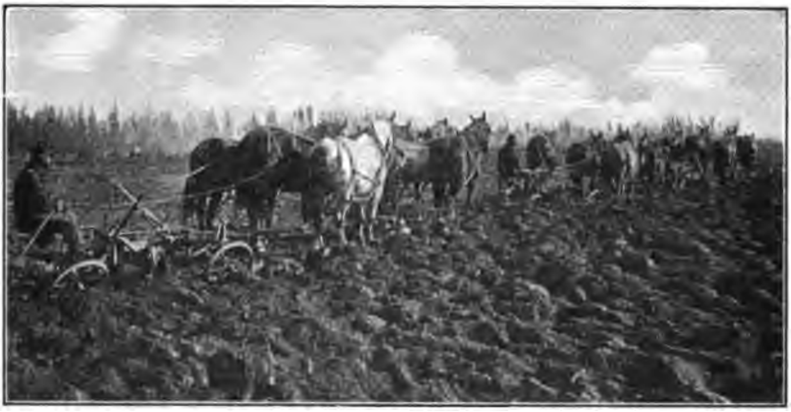
Before removing the stumps the land was worth about $16 per acre, but to-day each acre is worth $60. It has been planted to corn and potatoes and I invariably get better crops off the land cleared with Red Cross than off the other land not so cleared. I also secured a better stand on spots from which stumps have been blasted than from other portions.

I blasted and burned every stump on fifteen acres in seven weeks and did it alone, and Red Cross will be used exclusively on the 200 acres that I am going to clear next year.

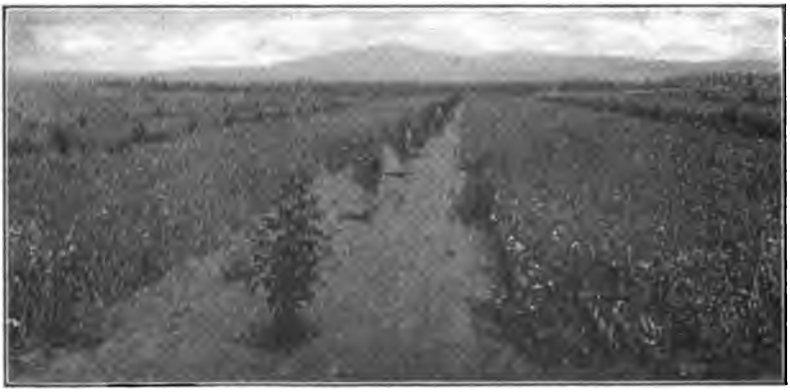
C. E. SAUNDERS,
Bergville, Minn.



ARCADIA ORCHARD CO., DEER PARK, WASHINGTON, CLEARING THE LAND



SAME. FIRST PLOWING OF CLEARED LAND



SAME. PLANTED WITH FRUIT TREES AND PEAS

Land Clearing Costs Nothing in the Long Run

Obviously the value of land is increased by clearing. In fact, many shrewd men argue that land clearing really costs nothing, if it is done reasonably economically, because the increase in the value of the land after it is cleared usually covers more than the cost of the clearing.

Unproductive Land Made Productive

I blasted from my property 1,000 white pine stumps averaging about two and a half feet, all of which were removed very successfully with Red Cross.

This land was always unproductive prior to 1910 when I started to farm, but by removing these stumps I have reclaimed about eight acres, which we planted to corn and potatoes in 1910 and 1911.

I have approximately 7,000 more stumps on this property, all of which will be removed as quickly as possible with Red Cross as I figure it the easiest, quickest and cheapest way to do the work.

IRWIN J. DREWS,
Hillman, Minn.

More Satisfactory Tillage After Blasting

The cost of tillage is greatly decreased by clearing. The blasting breaks up some of the subsoil, making it more mellow. Improved machinery can be used on cleared land, thus saving time and making it possible for the same amount of labor to handle much larger acreage. Cost of repairs of broken machinery is also saved by clearing.

$30.00 Worth of Red Cross Increases Value of Farm From $25.00 per Acre to $75.00

I have recently finished clearing out oak, chestnut, poplar and walnut stumps ranging from eight inches to eight feet in diameter, on all of which I used Red Cross.

The work cost me, including labor, on an average of 30 cents per stump or $30 per acre; while by any other method the work would have cost at least 50 cents per stump or $50 per acre. Furthermore, this land was worth but $25 per acre before stumping it, while its present value is from $60 to $75 per acre.

The stumps were mostly large; some were eight feet across, but I took them out with ten and twelve sticks of Red Cross. We have tried most every way of getting stumps out but find Red Cross the best.

C. E. SMITH,
Afton, Tenn.

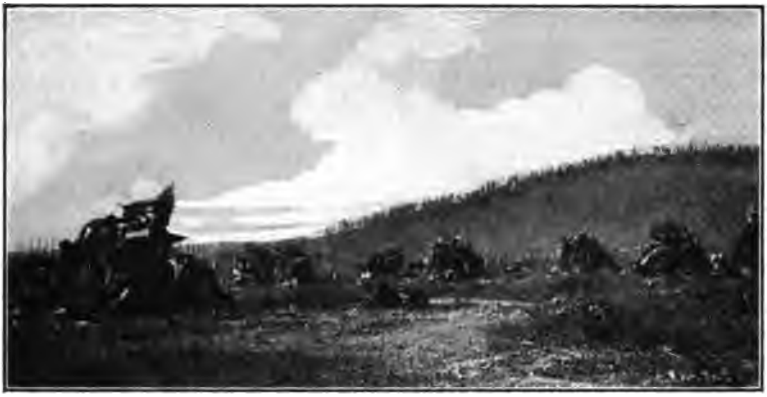
Red Cross Cleared Land Increased in Value 400 Per Cent.

I cleared twelve acres of new ground of gum, hickory, white and red oak stumps, ranging from twelve to thirty-six inches in size. For this work I used Red Cross and while the very cheapest figure at which I could have cleared this land by any other method would have been from 50 cents to 75 cents per stump or $25 per acre, Red Cross did the work for 20 cents per stump or $10 per acre.

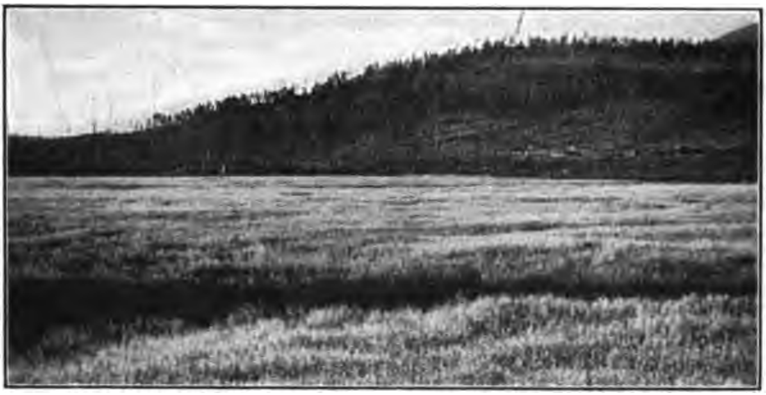
As fast as I blew the stumps out, I loaded them on wagons and sold them for $1.50 per load. They were blown in such pieces as to make them very fine for fireplace wood, not needing any more splitting, and the people in the neighborhood were very eager for them. After deducting the amount received from the wood, it brought the expense of clearing the land down to a very small item.

The land increased in value from $25 to $100 per acre. It was planted to alfalfa one year and produced a much better crop than the adjoining land on which no Red Cross had been used. The alfalfa grew very luxuriantly on spots from which the stumps had been removed.

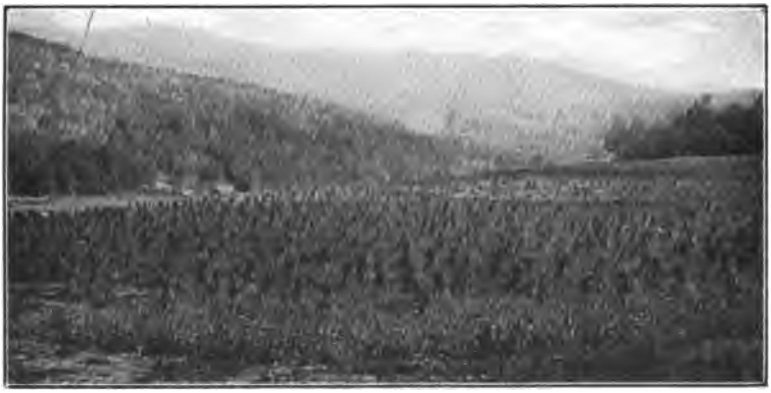
H. A. BEATTIE,
Starkville, Miss.



BLASTED STUMPS. MICHIGAN LAND AND LUMBER CO., CAREYWOOD, IDAHO



SAME LAND BEARING FINE CROP OF OATS



CORN ON CLEARED LAND, 75 BUSHELS TO ACRE, ONE YEAR AFTER CLEARING. FARM OF J. C. LOOKER, RIXFORD, PA.

Less Labor Required If Stumps Are Blasted

Every farmer knows that competent, reliable farm labor is scarce and hard to find when needed the most. The method of clearing, therefore, that will permit of the greatest amount of stump and boulder disposal with the fewest men, is, all things considered, the best. Blasting is undoubtedly that method.

Used a Ton of Red Cross a Week

I am using a ton of Red Cross a week for stump blasting and the results are marvelous. Great chestnut and oak stumps succumb to Red Cross as easily as lifting a match and the benefit derived from this method is incalculable, as it practically loosens the earth or subsoil from stumps and makes plowing easy.

FRANK S. BARR,
Lancaster, Pa.

Red Cross a Money and Labor Saver

Since I have learned to use Red Cross, I have found that it is a money and a labor saver, as well as a time saver, and if we are to make any headway in this section clearing land, we must use Red Cross or we will not have farms until we are old men.

Stumps often average 100 to the acre, yet they can be taken out quickly and easily with Red Cross.

Stumps when split with Red Cross burn easily and are soon gotten rid of.

The use of Red Cross for blasting boulders is becoming very general, and is so cheap as to make the use of other means of disposing of them ridiculous.

For ditch digging in wet and low places, Red Cross certainly is the thing as it cheapens the cost of doing the work, permits of ditching being done where it is impossible to get in with machinery and horses, and also allows the work being done in a short time.

In 1911 I used 1,300 pounds of Red Cross on thirty-five acres and will use nearly as much this year, and cheerfully recommend it for land clearing.

JORGEN JUHL,
Askov, Minn.

The 700 stumps on the ten acres that I have cleared have been blasted with Red Cross and I have found it a cheap, easy way of clearing land. For boulders also it cannot be beat.

Stumps are free from dirt when Red Cross is used and broken and easily handled. A man and Red Cross can remove a large number of stumps in a day.

After the stumps are removed with Red Cross, the ground works easier and is more productive.

E. L. STEVEN,
Remer, Minn.

Blasting at a Cost of 15 Cents per Stump

I used Red Cross for clearing white oak stumps ranging from two to three feet in diameter. The work, labor and all, cost about 15 cents per stump or an average of $36.60 per acre; less than half what it would have cost to have cleared it by any other method.

Before the land was cleared it was practically worthless, it is now valued at $90 per acre.

GEORGE L. FISCUS,
Egg Harbor, N. J.

Even An Amateur Gets Results

Used Red Cross for stump blasting and was "tickled to death" with the way it worked. Never handled any before, but certainly had good results.

A. S. BILLINGS,
Omaha, Neb.

Combination Methods

Stump pullers are on the market operated by hand power, horse power, gasoline engine, etc. On clearing jobs large enough to warrant an investment in a puller, Red Cross and the machine work nicely together. All men have their individual tastes and preferences. Some swear by explosives and will have nothing to do with stump pullers. Others pin their faith on the puller and will use no explosives. A third class takes the middle ground, and uses both in conjunction. They claim a saving in time and money is effected by the combination. There is merit in their contentions, too. They argue that a puller does not break up a large stump so that it can be conveniently disposed of, also that a stump pulled out has immense quantities of dirt clinging to the roots and leaves a large hole in the ground to be filled.

Did you ever clear a mass of clay off the roots of a stump? No? Then there's one hard, disagreeable job you have missed. By using some Red Cross the stump is loosened, the anchor roots are broken, and much of the dirt is shaken off and is left in the hole after the stump is pulled. If the charges are properly loaded the stump will also be well split up so that it will be easily handled after it is pulled. It doesn't require as much powder to loosen up and split a stump in this way as it would take to blast it out cleanly.

Therefore, it will be seen that the advantages of using a puller and powder in conjunction are these:

(1.) A saving in powder;

(2.) A saving in time;

(3.) A saving in labor;

(4.) Less strain on machinery, horses and harness;

(5.) Greater ease in handling the stump after it is out;

(6.) Does away with the disagreeable and time-consuming work of clearing dirt off the roots;

(7.) Does away with a large part of the work of filling the hole.

Of course, where time is an important object, or in cases where it is inconvenient to employ a crew of men large enough to operate a stump puller, or when the amount of clearing to be done doesn't warrant the purchase of a puller, larger charges of explosives can be economically employed to blast the stumps cleanly.

Stump wood, when broken up into fragments of the right size, makes mighty fine firewood, especially for open fireplaces. Isn't it cheerful, though, sitting in the living room on a cold winter's night, before a roaring, old-fashioned open-grate fire?

Comparative Costs

Because of the different amount of work done by dynamite and by stump puller, in a given period of time, it is impossible to compare the costs of each per day, at least directly. It is more feasible to compare the cost per acre or per average-sized stump, because blasters seldom keep accurate accounts of the different items, and owners of pullers are likewise neglectful; it is not easy to get hold of any accurate figures. We are able to furnish statistics as to the relative costs of the two methods in the Southern Pine regions. We are indebted to the Mississippi Agricultural Experiment Station for the basis of the computation.

Average Cost With Mechanical Puller Alone

Puller and two yoke of oxen, per day	$5.00
Three men at $1.50 per day	4.50
Total	$9.50
Number of stumps averaged, per day	40
Cost per stump 1-40 of $9.50 =	.24

Average Cost by Blasting

(Labor figured at $1.50 per day)

Cost of boring stump	$0.025
Cost of charge of explosives (average)	.07
Cost of detonator	.01
Cost of fuse	.01
	$0.115 or 11c.

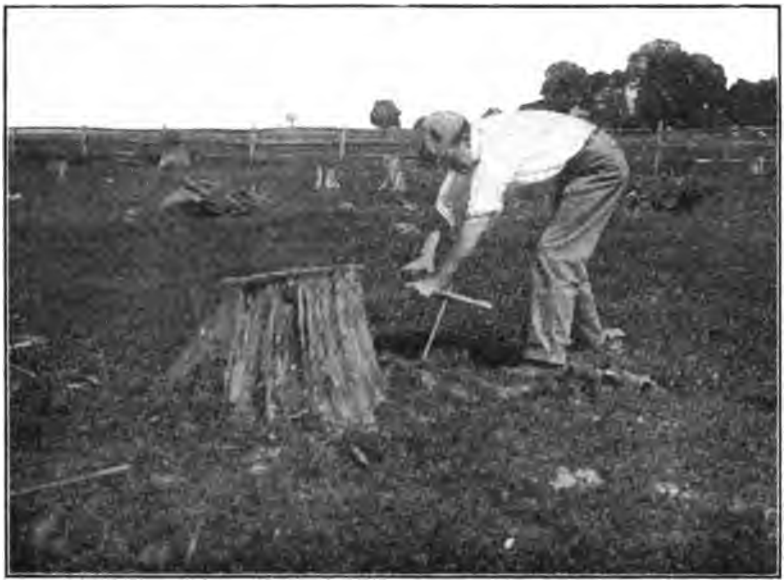
This indicates a saving of at least 12c. per stump by the use of explosives. Figuring 100 stumps to the acre, which is certainly not excessive, the saving will be $12 per acre. Possibly, by using puller and explosives together, a still lower average could be attained.

The extremely low cost of blasting a stump is further illustrated by these figures which we quote from the Engineering Contracting Magazine of May 13, 1908. They refer to the blasting of 3,500 stumps 18 inches to 7½ feet in diameter, averages, of course, being given. This work was done on Long Island.

Cost Per Stump

Labor (at $2.00 per day)	$0.059
Explosives	.086
Caps	.008
Fuse	.009
Total cost per stump	$0.162

By preparing the charges the evening before, one man blasted 100 stumps in one day, thus reducing the labor item to a little over 2c. per stump. It will be observed that these were very large stumps. Of course, the skill of the blaster counts for much. The more care and judgment is used, the more economical the blasting.



BORING HOLE UNDER STUMP WITH DIRT AUGER. THIS CAN ALSO BE DONE WITH A POINTED BAR

WOMAN OPERATING BLASTING MACHINE

"Red Cross for Me All the Time"

I blasted from my property 1,000 white pine stumps averaging about two and a half feet, all of which were removed very successfully with Red Cross.

This land was always unproductive prior to 1910 when I started to farm, but by removing these stumps I have reclaimed about eight acres, which were planted to corn and potatoes in 1910 and 1911.

I have approximately 7,000 more stumps on this property, all of which will be removed as quickly as possible, and it will be Red Cross for me all the time.

IRWIN J. DREWS,
Hillman, Minn.

After Using Red Cross Would Not Sell Land for $100.00 Per Acre Which Was Not Worth $5.00 Before

I follow agricultural blasting among the farmers of this section, and have used a great amount of Red Cross in this work.

In stump blasting I have used Red Cross on all kinds and all sizes of stumps in cultivated and uncultivated fields, and my experience has been that it is not only quicker and more satisfactory than any other method but it is cheaper by two-thirds.

As to boulder blasting probably the following experience may be of some interest to you:

In 1904 one of my neighbors bought a farm of about 108 acres. There was one field of about twenty-five acres that had never been cleared up and boulders lay so thick that I have crossed the entire twenty-five acres without stepping on the ground. They ranged in sizes from one-half ton to twenty tons, and many of them weighing from five to eight tons were imbedded in the ground so that I could see nothing but the top.

I contracted with Mr. Buechner to break up all the boulders on this twenty-five acres in shape to draw. I used four boxes of 40 per cent. Extra Red Cross, which, together with my labor charge, cost him $78 to get all these boulders ready for a team.

Before I started to work on this land it was absolutely worthless, but since then I have seen sixty-two bushels of wheat to the acre grow on that field, also fifty-two bushels of oats per acre and 140 bushels of corn. Furthermore, Mr. Buechner has since refused about three times the price that this farm cost him, and it was nothing but Red Cross that put it in shape.

R. T. VAN DUSEN,
Manlius, N. Y.

It is all quite true what Mr. Van Dusen stated. The land was not worth $5 before, but is as good now as any in the neighborhood. I would not sell it for less than $100 per acre.

GODFREY BUECHNER,
Manlius, N. Y.

Cost Cut in Two; Value of Land Doubled

Used Red Cross for blasting 200 white and black oak stumps, ranging from 8 to 24 inches in size.

I cleared about two acres at a cost of 15 cents per stump, or $15 an acre; and feel sure that the cost by any other method would have been from 30 to 40 cents per stump or from $30 to $40 per acre.

Another point, at a cost of $15 an acre for doing this work, it increased the value of the land from $10 to anywhere from $30 to $40 per acre.

JAMES BACHLER,
Fredericktown, Mo.

A TYPICAL PIECE OF WASTE LAND

FINE COTTON ON RECENTLY CLEARED LAND. PLANTATION OF H. J. McELROY, CUBA, ALA.

Breaking Boulders

I have had excellent results in removing boulders and breaking them up with mudcaps. In Massachusetts, many boulders of granite formation, known as "hardheads" are found. They are usually round and smooth and frequently the larger portion of them is buried in the ground. They are regarded as a hard proposition by experienced blasters. If only a part of the boulder shows above the surface, I sound with a three-eighth inch steel rod five feet long with a sharp point and poker handle, to determine the size and position of the stone underground. I then place a relatively small charge of Red Cross under one end or one side, the discharge of which rolls the boulder out upon the surface of the ground. It then takes a small charge of Red Cross to completely shatter it. I frequently dispose of the pieces by placing them back in the hole, thus saving the expense of carting them away. There is usually room in the hole for all of the pieces and still allow for eighteen inches of top soil over them.

WINTHROP FILLEBROWN,
Bryantville, Mass.

Largest Boulders Successfully Blasted

I am sending you a photograph of a rock which weighed between six and eight tons. As shown by the picture one man could handle any piece of it after the blast. The farmer for whom this blasting was done had spent for labor from $50 to $60 in clearing five or six acres of small boulders. I cleared about as much for $8 by using Red Cross.

W. H. NANGLE,
Thorndale, Texas.

NANGLE'S BOULDER

Red Cross in the Turpentine Industry

What It Means to Owners of Cut-over Land and Turpentine Manufacturers

The manufacture of turpentine and rosin is a very important industry in seven of our Southern States. In 1909 there were 1,585 establishments engaged in manufacturing these products. The capital invested in the business was $12,375,000 and 41,959 officials and workmen were employed in the industry.

The supply of gum is becoming exhausted, so both turpentine and rosin are now being extracted from the wood.

Although it is a well-known fact that the stump contains a larger proportion of the material from which turpentine, rosin, tar, wood oil, creosote, etc., are obtained, than is contained in the trunk and branches of the tree, nevertheless until lately only the trunk and branches have been utilized by many manufacturers due to the excessive cost of getting the stump out of the ground and breaking it up into sizes that would go into the "hogs." A few years ago, however, the National Turpentine Company, of Georgia, did some experimental work with excellent results. These experiments are of as much interest to owners of cut-over land in the vicinity of turpentine manufactories as to the turpentine manufacturers themselves.

TURPENTINE STUMPS

In the course of making these experiments the National Company started using stump pullers, which required in themselves a rather heavy investment of capital, and to properly use which they were compelled to employ large crews of men and teams of horses, making the cost excessively high. Later, it was suggested to them that explosives could do this work much more efficiently and economically. The experiment was tried and Mr. T. B. Gautier, President of the Company, made the following report:

"When measured, the stump wood amounted to seventeen cords. The total cost of explosives and labor was $50.59, or an average of about $3 per cord. These seventeen cords treated yielded eight gallons more of turpentine per cord, thirty pounds more of rosin and twenty gallons more of tar than ordinary wood. I am very much pleased with these results and expect to use explosives for this purpose hereafter. I certify that the attached report is correct."

Labor Cost

Boring holes, 1 man 7¼ days at $1.25	$9.06¼	
Chopping roots, etc., 1 man 28½ hours at 15 cents per hour	4.27½	
Piling and loading, 1 man 2¾ days at $1.25	3.43¾	
Piling and loading, 1 man 2½ days at $1.25	2.81¼	
Helper on ox team, 1 man 2 days at $1.25	2.50	
Ox team and driver, 1½ days at $3.00	4.50	
Extra help loading cars, 2 men ¼ day at $1.25	.63	
Total labor		$27.22

Explosives

304½ cartridges	$19.87	
400 ft. fuse at 50c. per hundred	2.00	
200 caps at 75c. per hundred	1.50	
Total Explosives		$23.37
Total Cost		$50.59
154 stumps were blasted; 17 cords produced; cost per cord		3.00

One cord stump wood produced 8 gallons more turpentine, 30 pounds more rosin and 20 gallons more tar than one cord of tree wood.

Value of this increase:

8 gals, Turpentine at 26c. per gal	$2.08
30 lbs. Rosin at 1½c. per lb	.45
20 gals. Tar at 12c. per gal	2.40
	$4.93

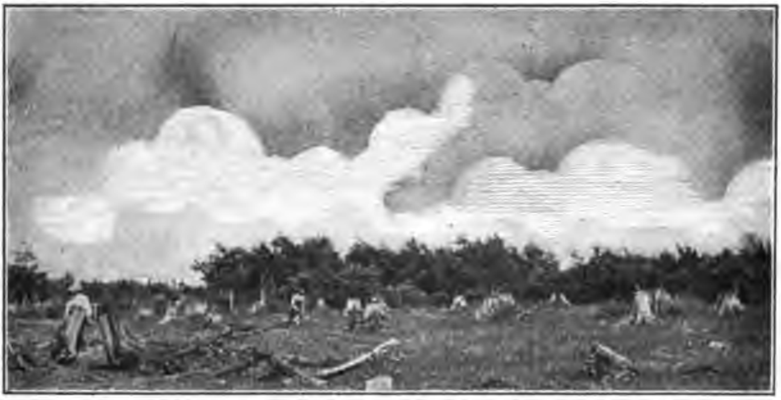
Giving a net profit of $1.93 in favor of stump wood.

The blaster who conducted these experiments for the Turpentine Company reports that the turpentine manufacturers are very much pleased with the results and that land owners are now figuring on using Red Cross for removing stumps from their properties and selling them to the Turpentine Company for $3 per cord, because that is what the Company is willing to pay for pine stump wood.

It is an admitted fact that land which has been covered with pine forests is very rich in plant foods and will yield bounteous crops if utilized for farms or orchards. The drawback heretofore has been to get the land cleared of stumps. The lumber companies have already cut the marketable timber. Some of the cut-over lands are still the property of the lumber companies. Many thousands of acres, however, have been sold at low prices to settlers who have been laboriously clearing it by digging, grubbing and burning a little at a time as they have leisure to devote to it.

These cut-over lands can now be cleared up rapidly at no actual expense to the settlers and lumber companies, for they will be able to sell the stumps to the turpentine manufacturers at a price that will, at least, fully cover the cost of the Red Cross and labor used in the clearing work.

SHOWING HOW BLAST BRINGS OUT ROOTS



GROUP BLAST WITH BLASTING MACHINE, BARKSDALE, WIS.

AFTER THE BLAST, BARKSDALE, WIS.

Apart from the far-reaching importance which this has to the agricultural development of seven Southern States, it is of greater magnitude to the poor settler, who will now be able to clear his lands and get them into shape for the production of large and profitable crops. Lumber companies still owning cut-over pine lands can now clear them and sell them as cleared land for at least double the price they can secure for them as stump encumbered land. In short, by clearing the land, they double its value at no expense to themselves, because the cost of the clearing is more than paid for by the money received for turpentine from the stump.

Value of Products Obtained From Blasted Pine Stumps Exceeds Value Obtained From Tree Wood

We obtained nine cords of wood from seventy-five stumps at a total cost of approximately $3.10 per cord delivered at our plant. This included a haul of about half a mile.

The value of the product obtained from this wood exceeded the value obtained from the tree wood. We have a crew at work shooting stumps now and expect to start another crew next week. From present appearances we will use larger quantities of Red Cross in the near future.

ATLANTIC TURPENTINE & REFINING CO.,
E. B. Smith, *Gen. Supt.*,
Savannah, Ga.

Pine Stumps Blasted Out, Split and Ready for the "Hogs" at $2.66 per Cord

As to the cost of producing stump wood for our plant with explosives.

The cost of the first sixteen cords was approximately $2.66 per cord for shooting out the stumps, chopping them to suitable size for our purpose and piling them ready for the wagons.

We have gotten out several car loads of stump wood at prices varying from $2.61 to $2.98 per cord.

We have recently made our first run of stump wood with very satisfactory results.

To-day we are ordering our second shipment of explosives and expect to use large quantities in the future.

STANDARD TURPENTINE COMPANY,
Per Frank L. Fogarty, *Acting Assistant Treasurer.*

The foregoing clearly proves the advantages of clearing land with Red Cross instead of by any other means, and the following is a condensed outline of the benefits derived by doing this work.

The stump-covered site of a former piece of woods is, as you know, new, rich soil that needs no fertilizer.

You also know that pulling stumps with a machine without first loosening them with explosives is hard work—liable to injure yourself or your horses, and certain to require a lot of work to get rid of the stump after pulling.

Then, too, it leaves the field full of holes, that must be filled; and plowing the hard, packed soil around old roots is no joke.

If instead of pulling the stumps you burn them out, the intense heat required destroys the humus in the soil all around the fire and you will have a burned field requiring a good deal of cultivating instead of new fertile soil.

Blasting splits up the stump into firewood, removes all the dirt, breaks all the main roots, and loosens the soil for yards around.

You can blast fifty stumps in the time it would take to grub and chop up one or two.

One man can do all the work, if necessary.

After the stumps are all blasted out, you will have a new, rich field, easy to cultivate, and which will yield bumper crops.

The split stumps can be removed easily to one place, burned, and the ashes saved for spreading on the land or for leaching.

If whole stumps are preferred for making fences, they may be blown out whole by regulating the charges.

Boulders, which you are now obliged to plow around, can be broken up into easily handled blocks by a single blast.

Red Cross not only removes your stumps and boulders, but at the same time subsoils your land. The action of the explosion is such as to loosen and shake up the subsoil for a considerable distance around, the blast thereby rendering the land porous and mellow, if the soil is dry at the time of blasting. It is an easy matter to pick out, after crops are grown, the various places where stumps have been blasted because of the great difference in yield as compared with the rest of the field.

All of the foregoing claims are conclusively *proven* by the letters of disinterested parties, who have tried our methods, which are quoted in this booklet. Follow their advice; take advantage of their experience; join the Red Cross Army and be the happy, prosperous owner of a productive, sightly farm.

STUMPS EVERYWHERE

Vertical Farming

The origin and character of soils, the nature and sources of plant food, and the necessity of good soil sanitation are fully covered in Vertical Farming, a book prepared by Dr. Gilbert Ellis Bailey, of the University of Southern California, and published by this company.

For satisfactory crop production the soils should be well drained, well aerated or ventilated, and well cultivated to a depth of several feet.

The chief troubles to be overcome in making soils conform to these specifications are hardpan, tight clay and poorly drained subsoils. Such subsoils prevent the downward movement of water into the soil, and permit it to be lost by evaporation, or worse by surface runoff, which causes erosion; exclude the air needed by beneficial bacteria and for the preparation of plant foods; seriously retard or absolutely stop the penetration of roots, and absorb too little water for the maintenance of crops.

Importance of Water Storage

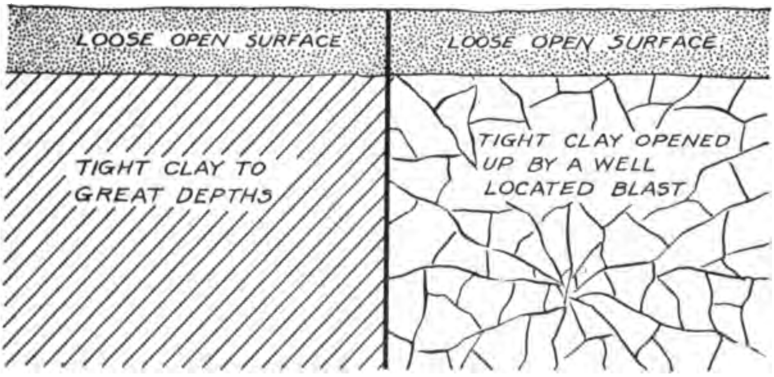
The greatest limiting factor in the production of crops in the United States is the scant supply of soil moisture during the growing season. This is especially true of summer crops. There is a sufficient rainfall annually in most of the general agricultural sections to increase the average yields to much more than double the present figures. The greater part of this is lost either through bad drainage or by surface evaporation and is never used by the plants. The first great care of the grower should be to store every possible drop of the rainfall in a well-tilled subsoil and hold it there indefinitely so that it may be available to nourish the crops during the summer when the rainfall is light and irregular, and when there is by far the greatest demand for water. Instead of laying up money for "a rainy day," it is "storing water for a rainless day."

The position and character of the impervious material in the subsoil governs very largely the extent and character of the damage done by the faulty absorption of moisture. Over a great part of the United

States we find a reasonably good surface soil underlain by a tight impervious clay to great depth. On such a soil the amount of moisture absorbed will be governed almost entirely by the surface, as the underlying material is too tight and close for the water to penetrate quickly to any considerable depth, and so it is lost by evaporation or by running off along the surface. The accompanying sketch illustrates this. The first rain soaks the few inches of surface to saturation, but cannot easily go deeper, and a very unsatisfactory as well as dangerous condition is produced. The good fertile top soil is held practically in suspension awaiting only a heavier rain to carry it off down the slope, leaving only the tight material that was below. Even if the condition does not become so extreme, and there is no loss by erosion, there can be but little absorption and storage of moisture and crops will suffer.

Blasting to Loosen Tight Subsoils

To improve the mechanical condition of such a soil the underlying material should be blasted to loosen it to a depth of not less than three or four feet. In some cases it is better to go deeper. When such a treatment is given, the movement of moisture is at once affected. Instead of being checked at the bottom of the plowed furrow it penetrates immediately into the subsoil where it can spread out at will and where it will be absorbed and later used to supply the needs of the growing crop.


LOOSE OPEN SURFACE
LOOSE OPEN SURFACE
TIGHT CLAY TO GREAT DEPTHS
TIGHT CLAY OPENED UP BY A WELL LOCATED BLAST

FOR DEEP, TIGHT CLAY BLASTING SHOULD BE DEEP AND THOROUGH, AND SHOULD BE DONE WHEN THE CLAY IS DRY

This work should be undertaken toward the close of the dry season, July to October preferably, when the subsoils are usually in the very best condition for shattering. It will then absorb the heavy winter rains and snows and hold them for future use. Impervious clay is usually plastic or sticky, and if blasted when wet will not be benefited and may even become more objectionable than before. When dry it shatters and pulverizes well and is converted into a cracked, porous mass that will permit the circulation of both air and water, and the deep downward growth of roots. It is in this cracked condition that it absorbs the maximum amount of water and produces the heaviest crops.

One Blasting Suffices for Several Years

The duration of the benefits thus obtained is not as yet clearly worked out, but it appears from tests that they should be effective for a considerable number of years. So far they have been more marked during the second and third years after blasting than during the first. If proper attention is given to the surface it is quite unlikely that they will return to their former state within the life of man. When heavy, deep-rooted crops such as alfalfa, for instance, are used to supply humus and increase the supply of nitrogen, the deep roots left to decay in the soil will guarantee the permanency of the benefits. *Planting of a deep-rooting crop should always follow subsoiling.*

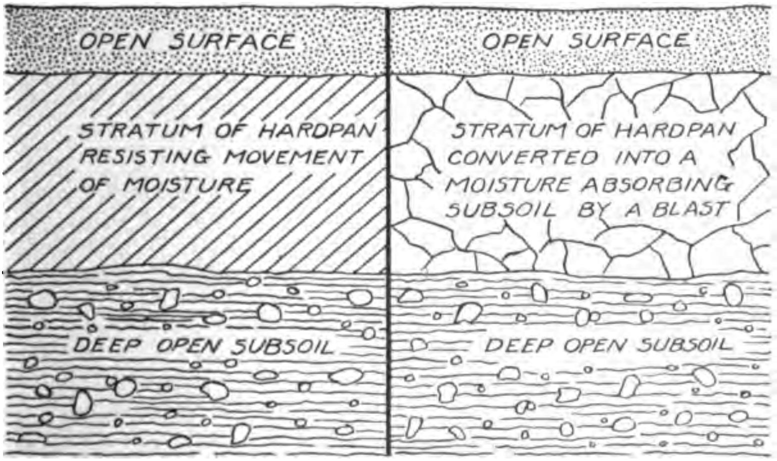
Lime Valuable Under Some Conditions

On sour, wet land, where the clay is very sticky, it will be found an excellent practice to use considerable amounts of lime in order to sweeten the soil and to assist in the formation of an ideal crumb structure. *Do not blast subsoil while it is in the sticky state. NO GOOD will come of it.*

Hardpan

Another prevalent subsoil trouble is encountered in the layers of hardpan so often found within two or three feet of the surface. These act just as do the tight clays, already described, in preventing the absorption of moisture and are likely to be the cause of serious trouble from erosion, in addition to limiting the crop-producing capacity of the soil.

In blasting such a soil, to get the most benefits, the explosive must be placed in the layer of hardpan without reference to the exact depth of the loading. Sometimes this may be not more than two feet in depth, and again it may be best to go as deep as three or four feet. The effect is to break up the hardpan and permit the moisture to

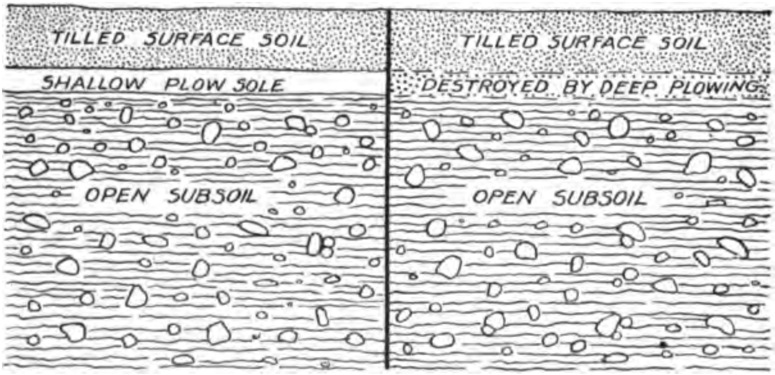

OPEN SURFACE
STRATUM OF HARDPAN RESISTING MOVEMENT OF MOISTURE
DEEP OPEN SUBSOIL
OPEN SURFACE
STRATUM OF HARDPAN CONVERTED INTO A MOISTURE ABSORBING SUBSOIL BY A BLAST
DEEP OPEN SUBSOIL

A LAYER OF HARDPAN OVER OPEN MATERIAL IS EASILY DESTROYED BY BLASTING. THE CHARGES SHOULD BE PLACED IN, AND NOT UNDER, THE TIGHT MATERIAL move freely. This increases the amount that may be absorbed and permits the growing of maximum yields. The effect on root development is the same as when the deep clay is blasted.

In such a soil the blasting not only makes soil out of the hardpan, but opens up the way to the underlying good subsoil so that it, too, may assist in nourishing the crop.

Plow Sole

Plow sole may be found either in connection with the other impervious conditions or alone. It lies closer to the surface and may not extend deeper than eight or ten inches. When such a condition is encountered the most satisfactory relief is by thorough and deep surface tillage. If it can be broken up by deep plowing, that is the best way to get after it. When this is not practicable, and the tillage must go deeper, a machine like the Spaulding Deep Tillage Machine offers the best relief, as it will not only break up the plow sole, but will mix it with the better aerated surface soil, and materially hasten the preparation of an ideal cropping soil.



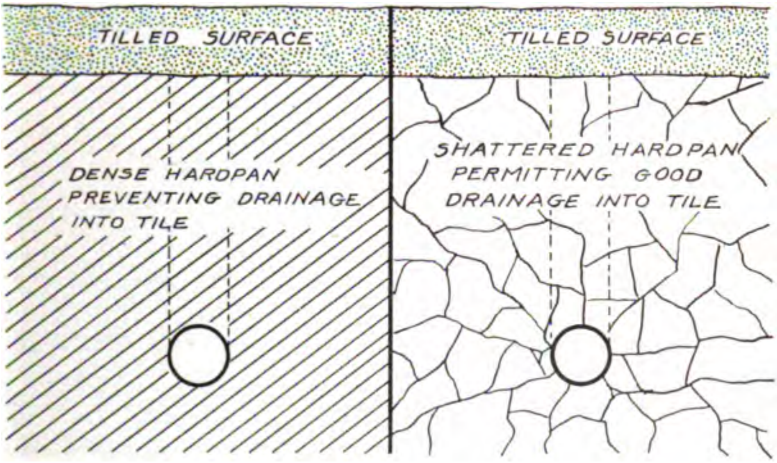
PLOW SOLE OR SHALLOW HARDPAN IS MOST EASILY BROKEN BY PLOWING TO GREATER DEPTHS. THIS MAY BE DONE IN CONNECTION WITH BLASTING FOR PULVERIZING DEEPER HARDPAN

The combination of deep surface tillage and blasting becomes applicable when both shallow hardpan or tough plow sole are encountered in connection with deep hardpan or tight clay. When only one adverse condition is encountered, the treatment selected should be the one applicable to the condition.

Sometimes a soil is found where the surface and upper sub-surface are well tilled to considerable depths and the tight clay is not found except at a considerable depth. Such soils lend themselves readily to subsoil blasting, as the great benefits of the naturally deep soil can be materially increased by creating still more open material to absorb more water and to give better drainage in case of torrential rains. Such blasting must be deeper, and heavier loading may, in some cases, be found advisable.

Blasting to Assist Drainage

Aside from the benefits of explosives for shattering impervious subsoils as above described, this method of soil tillage finds ready application in shattering subsoils to assist other drainage methods that are not giving satisfactory results. Tight clays and hardpan soils where tile drains are found to function poorly and establish drainage courses slowly, if at all, are found to be greatly improved by shattering the subsoils between the lines of tile. The same is found to be true in soils that are but little affected by open drains, where the water is held in too large amounts in the subsoil quite near the drains. Care, however, must be taken not to blast nearer than seven or eight feet to a tile drain.


TILLED SURFACE
TILLED SURFACE
DENSE HARDPAN PREVENTING DRAINAGE INTO TILE
SHATTERED HARDPAN PERMITTING GOOD DRAINAGE INTO TILE

OFTEN HARDPAN PREVENTS THE DRAINAGE WATER FROM PASSING INTO TILE OR OPEN DRAINS. THE RELIEF IS THROUGH BLASTING, WHICH OPENS UP THE NEEDED DRAINAGE COURSES

The reason why deep tillage or subsoil plowing is desirable is that all the soil below the bottom of the ordinary plow cut, in other words, everything below six to eight inches, is still in its primeval condition. It has never been disturbed. Chemical analyses of soils down to a depth of twenty feet show that on the average acre there are tons of plant foods which become available only when roots can penetrate to them, or when ascending moisture brings them up to the roots that cannot get down.

Soil Makers

Alfalfa and other deep-rooted plants are called "soil makers" because they penetrate this compact soil, introduce humus and provide a passageway for the descent and ascent of water which carries with it the soluble, fertilizing elements, but many subsoils are so hard that it is practically impossible for any plant to penetrate them. Even when this is possible there is no use in putting such a burden on the plant, because whatever vitality is expended in making its own home beneath the surface is subtracted from the vitality of the plant above the surface. In other words, the plant that has to fight for its life beneath the soil has little energy left for fruition.

If we make root growth easy and quick by breaking up the subsoil, then we make the fertilizing elements of the subsoil immediately available and save the energy of the plant for fruition. We also create in the subsoil a porous condition favorable to the storage of water at a depth that will not keep the soil cold, and yet near enough to the roots to feed them through capillary attraction. Subsoiling also introduces air into the soil, and it is just as necessary for the roots of a plant to have air as it is for a human being to breathe.

The effect of subsoiling virtually is to change a farm from a six-inch layer of topsoil to a six-foot layer.

Proof of the Theory

In 1911 and 1912 experiments were conducted in various parts of the country.

The results varied all the way from wonderful successes to dismal failures. (See extracts from customers' letters appended.)

In some cases crops on subsoiled land were three times heavier than before subsoiling.

In others they were actually less.

A soil expert was employed to find the reason. Also records of both successful and unsuccessful experiments and results were carefully studied.

Finally the simple solution was found.

Tight subsoil blasted when *wet* showed no improvement, or else actual deterioration.

Tight subsoil blasted when *dry* showed increase in crops varying from 25 per cent. to 300 per cent.; the average increase was better than 50 per cent.

Every good farmer knows that to plow wet soil damages it, because it packs and then dries out in large lumps.

Blasting wet subsoils is equally bad because the explosion forms potholes and plasters the wet subsoil against the sides of them, instead of cracking and pulverizing it as desired.

Think how it would reduce the cost of living if all farm yields were increased only 25 per cent.

EATONTON, GA., September 21, 1911.

Regarding the blasted field of cotton of J. G. Spivey:

Mr. Spivey told us that week that he picked two and one-quarter bales of cotton off of the one and three-quarters acres of blasted land the first picking and says he will get five bales from this piece of land when he finishes.

This cotton has been the talk of the country, and a great number of people have visited this particular spot. We are sure it is going to do your Company a great deal of good in the sale of Red Cross.

The picture shows blasted cotton. It does not do full justice, as the cotton blasted is about five or-six times as good, both in size and fruitage, as that which was not blasted. No one can well conceive the difference unless they were on the ground like the writer was some thirty days ago.

HEARN & GREEN HDWE. CO.

MR. SPIVEY IN HIS 2½-BALES-PER-ACRE COTTON

MRS. FOULKE'S ALFALFA CROP ON SUBSOILED LAND

Pennsylvania Department of Agriculture

Division of Farmers' Institute, Harrisburg

WEST CHESTER, PA., August 20, 1913.

E. I. du Pont de Nemours Powder Co., Wilmington, Del.:

GENTLEMEN:—It gives me pleasure to report to you that the experiment in subsoiling on my place, which was done a little more than a year ago, has proved very satisfactory.

I had for several years been trying to get "a stand" of alfalfa on the field, but while I could get "a set" and once or twice a first cutting I was unable in spite of my efforts to make the crop "stand" over a season.

I had tried all the methods of planting—liming—(ground limestone) inoculated soil, carefully selected seed and good cultivation, but to no avail, and in desperation last time I tried subsoiling—using one-half a stick of Red Cross every 15 feet at a depth of 3 feet. The result is apparent this year in a fine "stand" of alfalfa, from which in spite of the drought we have cut already two cuttings and expect to get another.

The alfalfa is luxuriant and strong, and I believe the subsoiling and subsequent cultivation and care have at last secured me a permanent crop.

Thanking you for your interest and help, I am, Yours truly,

JEAN KANE FOULKE.

The marked benefits of this subsoiling have continued. In the spring of 1915 the alfalfa was still good, with the exception of one acre, which was smothered out by a heavy drift of leaves from an adjoining grove. This was plowed up, revealing the fact that the subsoil had become far more porous and well tilled than had been expected. This will be well tilled and reseeded to **alfalfa.**

MR. JOHNSON'S COTTON ON SUBSOILED FIELD

Increased Cotton Yield 2½ Bales per Acre

Affidavit of J. H. Johnson

State of Alabama
Jefferson County

Before me, the undersigned authority, personally appeared J. H. Johnson, known to me, who being duly sworn, deposes and says:

I have been growing cotton and helping to grow it since I was large enough to work; one bale to the acre was as much as I ever grew until I commenced to subsoil my land before planting; this year I subsoiled one acre, using a half stick of 1¼ in. by 8 in. of Red Cross every 8 feet, and made 1,767 pounds of lint cotton on the one acre. I had a bad storm strike it this year, which reduced the yield below what it would have been; also had worms in it. I believe that good land, thus broken, properly fertilized and cultivated, during a good crop year, will produce five bales to the acre. I am now 57 years old. I made last year at the rate of 4½ bales to acre on another tract, subsoiled in same way, the season being better.

J. H. JOHNSON.

The substance of the above was sworn to and subscribed before me this 28th day of November, 1911.

THOS. T. HUEY, Notary Public.

Second Year After Subsoiling Gets Two Big Crops

Bessemer, Ala., 11-25-12.

E. I. du Pont de Nemours Powder Co.:

Gentlemen:—Referring to the acre of ground I subsoiled last year and on which I raised 1,767 lbs. lint cotton, take pleasure in advising you that on this same acre I raised 172 bushels of corn this year. Also wish to say that I raised what I consider an extra good crop of peas on this same acre this year.

It gives me great pleasure to say to my fellow-farmers that by subsoiling I believe crops can at least be doubled, or more.

Yours very truly, J. H. JOHNSON.

Sworn to and subscribed before me this the 25th day of November, 1912.

THOS. T. HUEY, Notary Public.

Subsoiling a Success on I. H. C. Demonstration Farm

INTERNATIONAL HARVESTER COMPANY OF AMERICA.
W. K. WOOD, MANAGER. W. A. RENN, SUPERINTENDENT.

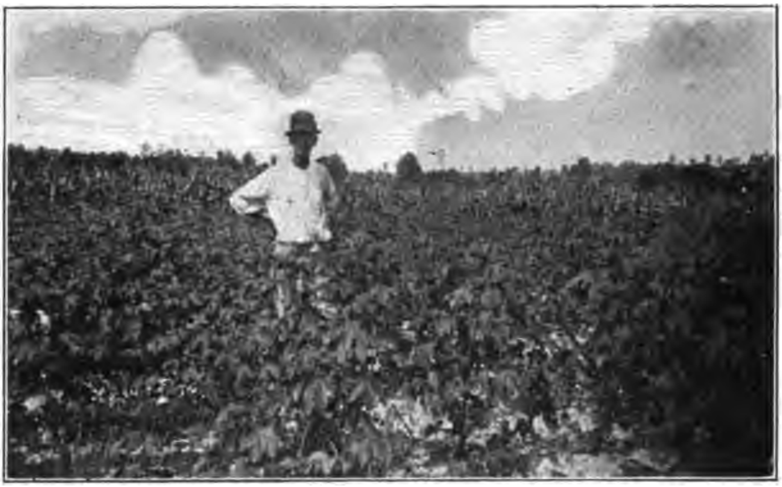
BROOKHAVEN, MISS., September 11, 1912.

Du Pont Powder Co., Wilmington, Del.:

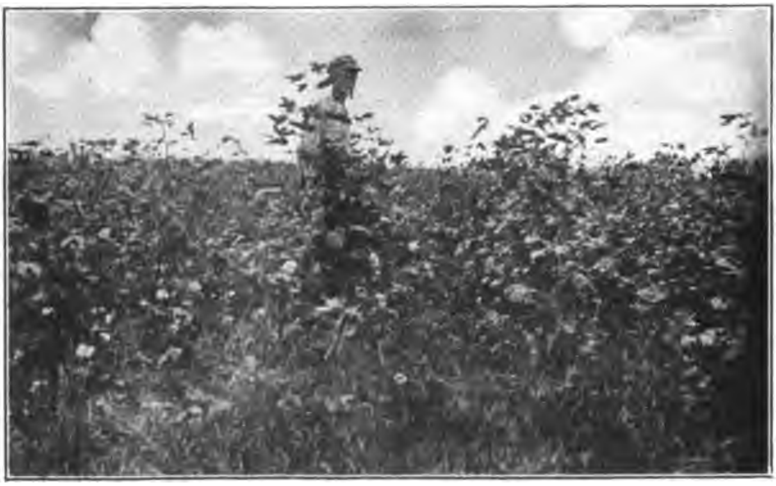
GENTLEMEN:—As requested I am sending under separate cover four views, one each of cotton and corn, not subsoiled, and one of each subsoiled.

You will note the great difference, and we will subsoil more extensively the coming year.

Yours truly,
W. A. RENN.



COTTON NOT SUBSOILED—DEMONSTRATION FARM OF INTERNATIONAL HARVESTER CO., BROOKHAVEN, MISS.



SUBSOILED COTTON, SAME FARM

EX-GOVERNOR STUBBS, CONGRESSMAN CAMPBELL AND GENERAL PORTER WATCHING SUBSOILING DEMONSTRATION IN KANSAS

A pioneer in subsoiling with Red Cross was General Samuel J. Crawford, ex-Governor of Kansas. Below is a letter from him that tells of his experience:

"I am glad the good work of blasting the compact subsoil and hardpan is moving along in the east as well as in the west, whether it be for the planting of trees, grain or anything else that grows from the ground. If the subsoil is loosened so that the rainfall can penetrate the earth, the roots of grain, grasses, trees, etc., will follow the water to their natural depth and draw their nourishment from five or six feet of soil instead of five or six inches of surface soil, as heretofore. Besides, the blasting creates sub-reservoirs in which to store the surplus rainfall which will supply the roots of the growing products with moisture, when the dry season is on. Again, if the ground is loosened so the water can pass down into sub-reservoirs, there will be no standing water on the surface to damage the crops or keep the farmers back with their work. Such treatment, properly applied, will revolutionize the agricultural and horticultural industries throughout the country.

"The government is spending millions of money for irrigation purposes in isolated places, which, from the nature of things can only benefit a few people, while the blasting process will benefit all the farmers and fruit growers at comparatively a nominal expense. By this process most of the worn-out farms in New England and throughout the country can be reclaimed and made to produce good crops. All that is necessary is for the producers to grasp the idea and learn how to handle explosives."

MR. COBB'S COTTON, SUBSOILED

MR. COBB'S COTTON, NOT SUBSOILED

Blasting Subsoil of Cotton Field Doubles Crop

WALHALLA, S. C., August 5, 1911.

GENTLEMEN:—I wish to tell you about my experience of using Red Cross on part of a field of cotton. The size of the plot was thirty feet by ninety feet. The soil of the whole cotton field was given the usual cultivation before sowing the seed. I am very greatly pleased to say that the small plot of blasted soil has shown a better crop, in fact the yield will be, in my judgment, between 800 and 1,000 pounds per acre, or more than *twice as many pounds of seed cotton* as will be picked from the same size of plot adjoining the blasted plot.

The success of this tested plot is so assured that I am going to use Red Cross on thirty to sixty acres of land now growing good crops. I feel that blasting the subsoil of these areas is going to result in greater crops. I figure that I can do this at a cost of four or five dollars an acre. In dry soil I use a quarter of a cartridge in holes placed fifteen feet from each other. This takes forty-nine sticks or cartridges to the acre, approximately twenty-five pounds. My test of blasting the cotton plot was the means of showing me how I can make my acres grow bigger, better and more valuable crops at small cost and increase the fertility of my farm.

W. R. COBB,
Steward, Oconee County Poor Farm.

Under date of September 14, 1912, Mr. Cobb wrote that the 1911 crop on the subsoiled plot yielded 1,500 lbs. per acre, as compared with 800 lbs. yield per acre on the unsubsoiled portion, and that the 1912 crop would probably be still better on the subsoiled plot. Both plots received the same cultivation and the usual fertilization with stable manure and guano.

Increased Wheat Yield 25 Per Cent.

Extract from letter of Mr. D. A. Beamer, manager, Missouri Immigration Association, Lamar, Mo., dated August 2, 1911:

"The writer, on his own account, blasted about three acres two years ago. The present season it carried a crop of wheat which was sown last fall. This three acres was part of a ten-acre field, and was decidedly the wettest and least productive part prior to the blasting.

"The wheat on this blasted ground was treated exactly like the balance of the ten acres of which it is a part, and the wheat on the blasted portion was at least 25 per cent. better than the balance on the ten-acre plot.

"As a result of my experience, I will subsoil ten acres of land this fall because the very first crop taken from the above three acres has shown a good profit on the cost of subsoiling."

This cut shows a plot of garden beets, the ones to the right planted on ground subsoiled with Red Cross ten days after those on the left were planted on ground not subsoiled. The beets on blasted soil matured very early and brought 75 cents per dozen bunches, the others were much later and brought only 40 cents per dozen bunches. Farm of H. B. Decker, E. Stroudsburg, Pa.

MR. FOWLER STANDING IN CORN ON SUBSOILED GROUND
(See letter on opposite page.)

A close inspection of this field was made during the dry summer of 1914, at which time it was found that the ameliorating effects on the subsoil had continued their good work. The old wet spots that had made the crops turn yellow or die, were no longer to be found.

On the hill soil that had been easily eroded before the blasting the washing had been controlled and, in the face of a low rainfall, the crop was fresh and green, the ears well developed, and far ahead of neighboring corn not so cultivated.

Record Crop on Blasted Ground

From *Ohio State Journal,* Columbus, Ohio:

Among the visitors to Columbus yesterday was J. S. Fowler, of Anderson, S. C. He is one of the original "explosive" farmers of the South, the new method of farming which is making the South proof against the drouths which have so often blasted the hopes of its farmers.

He brought with him pictures showing corn fields planted by the Red Cross method, to prove that the stories he told of the corn crops were not fabrications, absurd as they might sound to the ears of farmers in what is supposed to be one of the great corn-raising sections of the country. The land in the western part of South Carolina is good, and Mr. Fowler said that under the old method he had raised 100 bushels of corn to the acre on his plantation, which consists of 2,000 acres, but this yield has more than doubled under the new method.

This year he prepared four acres by blasting. Half a stick of Red Cross was used to each fifteen feet square, the explosive being placed in holes punched in the ground and then fired. It cost $18 an acre for the blasting. This stirred up the ground from three to four feet deep. It was plowed and harrowed in the usual manner and the corn drilled. Just before he came to Columbus, the time when the pictures were taken, officials from the government agricultural experiment station visited the field and estimated that the corn would yield 260 bushels to the acre. Mr. Fowler says that he does not believe that it will go that high, but states that he expects over 800 bushels from the four acres. Some of the stalks of corn have from three to five ears and all are large. The corn is about fifteen feet high and very uniform. Next year he expects largely to increase his blasted acreage. One blasting does for years, it is said, and the corn requires but little rain, as what does fall is held in the ground. Mr. Fowler says that the cotton crop in the South this year will be a record-breaker, in spite of the reports of dry weather. "We have learned many lessons," he said. "We are plowing deep for our cotton and the dry weather does not damage us as it once did. This year streams are dry, the cotton mills have closed because of failure of water power, but there has not been any damage done to the crops. Our new methods of farming have made us practically independent of the mid-summer drouths, and the cotton speculators who are counting on a short crop because of dry weather are going to be badly stung.

"Cotton has never looked better than this year in all the Southern States in which I have been, and the weather has never been so dry. Under old methods of planting the crop would have been almost a total failure. But now it does not show any damage at all. The Southern farmer is taking up new methods, and already he is beating the big yields once reported from Northern farms. This fall hundreds of old farms will be blasted and next year they will raise immense crops of corn and cotton. It costs money, but we are getting it back and have never been so prosperous."

Digest of Reported Subsoiling Results

Although subsoiling with Red Cross explosives has been successfully practiced in various parts of the country, it is difficult to get exact reports of many of the tests. Only a few farmers keep accurate records of their experiments, being satisfied to judge by general results.

We here present the gist of such definite reports as we have been able to secure.

These are, however, sufficiently numerous and varied as to crops and localities to demonstrate the broad utility of subsoiling with Red Cross under the conditions and with the methods we advocate.

Cotton

Before subsoiling got ¾ bale of cotton per acre. After subsoiling got 1½ bales.

M. M. SHANKE,
Brewton, Ala.

Blasted acre 1,735 lbs. seed cotton per acre; crop value $98.72. Adjoining unblasted acre 1,115 lbs. seed cotton; crop value $53.52.

JOS. WILLMAN,
Talladega, Ala.

Subsoiled acre 1,080 lbs. seed cotton; unsubsoiled acre 900 lbs. seed cotton.

JOHN P. FONTAINE,
U. S. Dept. of Agric., Linden, Ala.

Subsoiling produced one-third more cotton than taken from adjoining land. The subsoiled cotton yielded 40 per cent. of lint, against 33 per cent. of lint from unsubsoiled cotton.

C. OF GA. R. R. TEST FARM,
Dawson, Ga.

"The five-eighths acre plot that was blasted will make between 3 and 5 hundred lbs. more of seed cotton than the other; so you can readily see that it really doubled the yield."

BEN S. MOONEY, Spl. Agent,
Dept. of Agriculture, Statesboro, Ga.

1911 cotton crop 5 bales to the acre on subsoiled land.

F. V. MOOSE,
Gainesville, Ga.

Subsoiled three-fifths acre produced 800 lbs. seed cotton against 470 lbs. seed cotton from adjoining unsubsoiled acre. The subsoiled cotton sold for ½c. a lb. more than unsubsoiled cotton.

W. A. BONDS,
Ratliff, Miss.

Planted corn and cotton on subsoiled land, and their report was a set of photographs with "you will note the great difference and we will subsoil more extensively the coming year."

INT. HARVESTER CO.,
Brookhaven, Miss.

Corn

Before subsoiling 25 bushels of corn per acre. Since subsoiling over 100 bushels of corn.

W. E. FIKE,
Marbury, Ala.

Before subsoiling got 22 bushels of corn per acre. Since subsoiling and after a severe hailstorm struck the crop, got 82 bushels of corn and fine yield of peas per acre.

S. C. BEAVERS,
Talladega, Ala.

The subsoil plot last year produced about 40 bushels of corn. This year it produced 106 and a fraction bushels.

WARNER SMITH,
Blue Ridge, Ga.

Subsoiled acre produced 87 bushels of corn; unsubsoiled land 60 bushels. This subsoiled acre won 2 prizes in the Corn Club; one on point of yield, one on point of profit.

L. W. SMITH,
Colbert, Ga.

One hundred and fifty bushels of corn off subsoiled prize acre.

JAS. F. BATTS,
Oakland Farm, Garner, N. C.

Fifty bushels of corn on subsoiled acre. "Only made one-half as much corn" on unsubsoiled acre.

R. F. RICE,
Greensboro, N. C.

Land was wet and spongy, and the crops were always a failure. By subsoiling 4 acres got a corn crop in 1912, besides increasing the value of the land $20 an acre.

JOS. WALLACE,
Nicholasville, Ky.

Corn increased 33 per cent. after subsoiling. Vouched for by Chamber of Commerce of Spartanburg, S. C.

J. H. CALDWELL,
Spartanburg, S. C.

Subsoiled corn 50 per cent. better.

JAMES R. BUFORD,
Lawrenceville, Va.

1911 crop 95 bushels of corn per acre subsoiled ground; 70 bushels unsubsoiled acre.

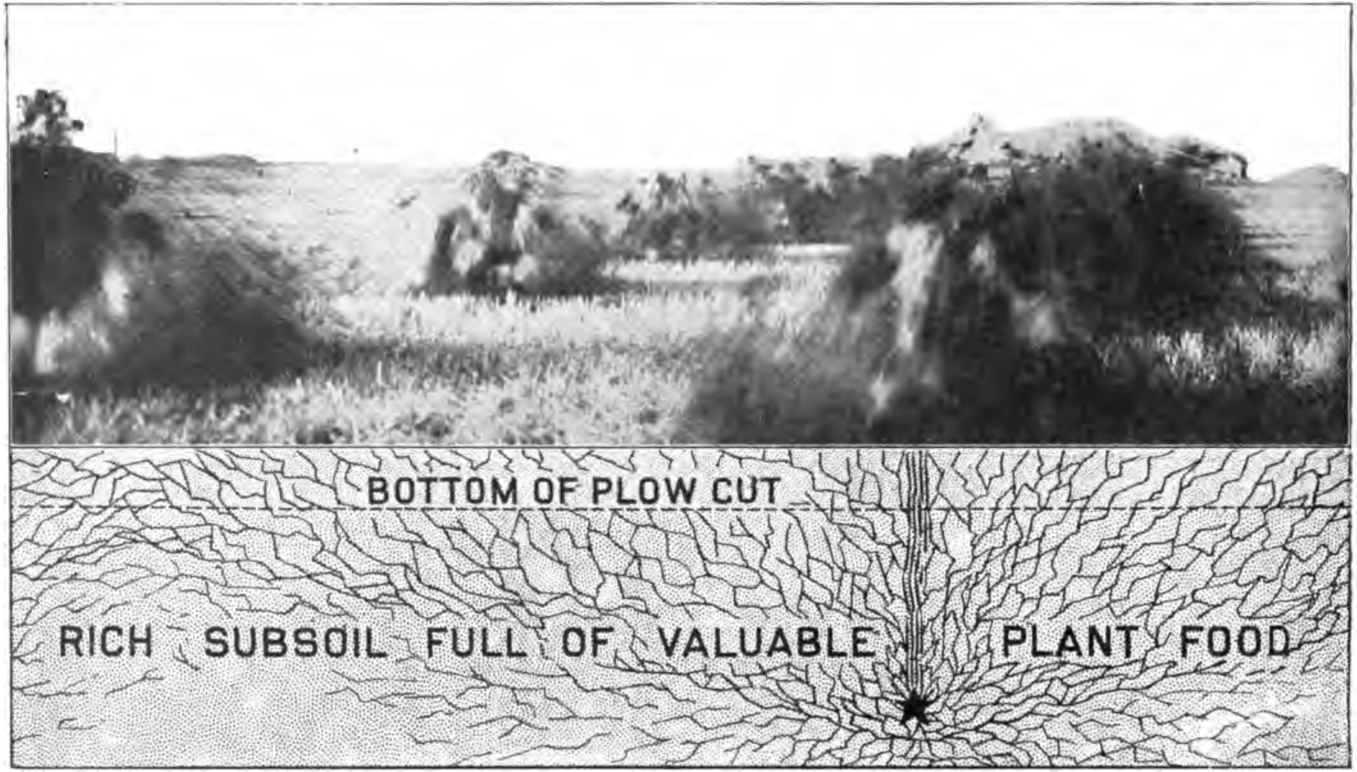
S. L. SMITH,
Supt. of Schools, Clarksville, Tenn.

One hundred and five bushels of corn per acre, one-half subsoiled and one-half unsubsoiled. Subsoiled corn one-third better. Increased potatoes one-third. Then put in clover and alfalfa and "have great deal better stand where I subsoiled."

T. F. KIDD,
Crockett, Va.

Gov. Brown, in an address reported in the *Atlanta Constitution,* states that he got 106 bushels of corn per acre after subsoiling. Former yield had been 25 bushels.

HON. JOSEPH M. BROWN,
Atlanta, Ga.



KANSAS HARDPAN BLASTED WITH RED CROSS, WITH SECTIONAL VIEW OF SOIL

Subsoiled area produced more than twice as much corn as the ground on either side.

INT. NURSERY CO.,
Denver, Col.

Before subsoiling got 30 bushels of corn per acre. After subsoiling, without fertilizer of any kind, got 49.40 bushels of corn per acre. Vegetable garden also subsoiled and produced better crop, both quality and quantity.

JOHN J. RASKOB,
Wilmington, Del.

Subsoiled 14 acres of poor land for corn. No exact figures, but "corn crop was much better on the subsoiled land than on the other half of the field."

HENRY P SCOTT,
Delaware City, Del.

Although the season was good for corn, the subsoiled plot showed an increase of "not less than 20 bushels of corn per acre; and am expecting better results this year."

W. H. SHRIVER,
Kimmundy, Ill.

On a 4-acre plot, one-half subsoiled and one-half unsubsoiled, there was "a difference of 23 1-3 bushels per acre in favor of the blasted plot, and the corn on this plot was worth at least 10c. more per bushel."

GEO. S. BLISS,
Fort Wayne, Ind.

Subsoiled 3 acres. Best yield had not been more than 5 bushels of corn per acre. After subsoiling got 30 bushels of corn per acre. Cow peas on subsoiled land were 6 inches taller and averaged ½ ton more per acre than on unsubsoiled land.

J. C. GARST,
Madison, Kan.

Shot subsoil with the main object to correct drainage. Had better corn on that reclaimed land than on the other good land.

GEO. SPANGENBERGER,
Hutchinson, Kan.

Blasted area produced 24 bushels good corn; unblasted 18 bushels, one-third small and soft. Subsoiling made one-third more fodder. (This is equivalent to 36 bushels per acre increase.)

SAMUEL SCHRACK,
Mifflinsburg, Pa.

Subsoiled 1 acre as a test. "I have succeeded in increasing my corn crop just 50 per cent."

G. ZACHEOSIAN,
Richland Center, Pa.

There was an increase of about 20 per cent. in the corn on the subsoiled land. Had hay in the field the first year, but the first year's increase was not so great as the second.

SAMUEL K. WENRICK,
Robesonia, Pa.

Subsoiled ground produced 50 bushels 20 lbs. good corn. Unsubsoiled 26 bushels, 4 lbs. corn not first class. Millet on subsoiled ground was 25 per cent. better than on the other ground. Tomatoes on blasted land averaged 72 lbs. to the plant; unblasted land 40 lbs. to the plant.

A. E. THORNBER,
Brookings, S. D.

Corn on subsoiled strip better in color, taller and bore larger ears than surrounding corn.

JOHN CAMP,
Newark, Ohio.

Subsoiled land planted to corn and pumpkins, followed by wheat, clover and timothy. The corn and pumpkins were better than the balance of the field; and the wheat, clover and timothy on the subsoiled land were far ahead of the unsubsoiled.

JACOB LORENZ,
Cumberland, Ohio.

Milo on subsoiled ground much better than on unsubsoiled. This is an exceedingly good season when the difference was not so marked as it would be in unfavorable seasons.

J. E. MUNDELL,
Bureau of Plant Industry, Dept. of Agriculture, Tucumcari, N. Mex.

Oats, Wheat, Forage, Etc.

Subsoiled portion of field that was not as fertile as other portions and was wet and swampy, but the crops of oats "exceeded that of the more fertile part of the field."

J. R. SANDERS,
Campbellsville, Ky.

Subsoiled land produced "at least twice the amount of hay" as the part unsubsoiled.

KNOB APPLE ORCHARD CO., INC.,
Preston, Va.

Land worthless and unproductive before blasting, produced "fine yield of grain" after blasting.

A. E. COLE,
Chamblee, Ga.

Three acres before subsoiling produced 18 bushels of wheat per acre; since subsoiling 25 bushels of wheat per acre.

D. A. BEAMER,
Lamar, Mo.

Subsoiled 3 acres. Subsoiled crop was 6½ to 7 tons of alfalfa per acre; unsubsoiled crop 4½ to 5 tons per acre. Got 7 cuttings from the subsoiled land, 5 cuttings from unsubsoiled.

C. L. MURPHY,
Glenwood, Iowa.

"Subsoiling has not had a fair trial. At harvest time subsoiled acre cut twice as much hay as land of the same nature, with the same preparation. The hay was also cleaner and of better quality."

B. F. MEBANE,
Spray, N. C.

Where alfalfa was blasted "there was a much heavier crop and finer quality."

W. H. BOWMAN,
Beatrice, Neb.

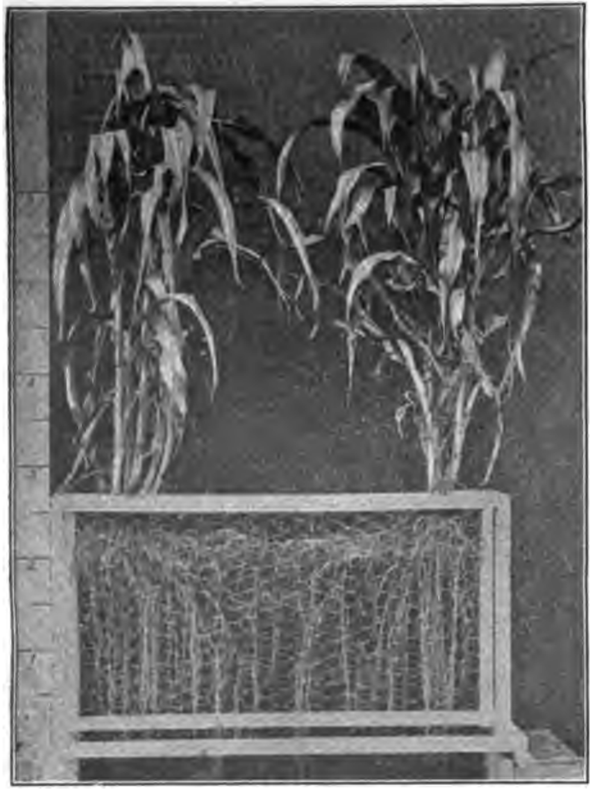
Forty to forty-five bushels of oats on subsoiled area; 20 to 25 bushels of oats on unsubsoiled area. "The facts are, we were unable to grow anything in the way of oats, or any other thing, until you improved the land."

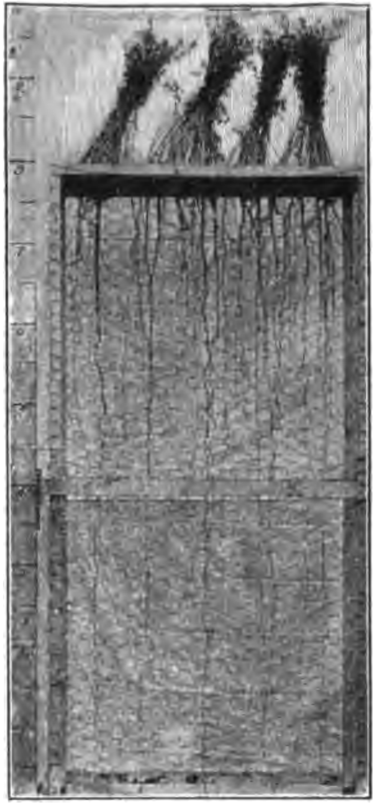
N. Y. STATE FAIR ASS'N.
Syracuse, N. Y.

Oats and peas gave splendid crop, "and the rows of fodder corn, to say the least, 100 per cent. better than the corn planted the season before."

W. S. MYGRANT,
New York City.

If it costs the value of twenty bushels of corn to raise and market an acre of corn, you are doubling your profits by increasing the yield from 25 bushels to 30 bushels or from 40 bushels to 60 bushels.





SHOWING HOW CORN AND ALFALFA ROOTS GO DOWN INTO SUBSOIL

Photos made by Prof. Ten Eyck, Kansas Experiment Station

Garden Truck, Etc.

Wonderful crop of melons and cantaloupes after blasting. Fifty melon vines produced over 250 fine large melons.

W. W. STEVENS, Orchardist,
Mayfield, Ga.

One-tenth acre subsoiled produced 1,174 2-lb. cans of tomatoes and beans; 700 cans was the best that could be obtained on unsubsoiled.

W. M. BROWN, Field Agent,
Southern Railway Co., Manassas, Va.

Blasted very poor soil. The peas were 6 ft. tall on an average. Adjoining soil, much better than that subsoiled, produced crop of peas 1½ ft. tall, very thin and yellow in leaf.

E. V. HARBECK, M. D.
Weaverville, N. C.

Subsoiled one-quarter acre "crab lot." Nothing would grow there, but since blasting "I got all the garden truck that the family could eat, and sold about $100 worth in addition. This land is now worth $100."

A. M. GARRELL,
Hambleton, W. Va.

"The yield of large smooth sweet potatoes was twice as much on the subsoiled acre as on the adjoining land unsubsoiled."

OTTO LOCKE, Prop.,
Comal Springs Nursery, New Braunfels, Texas.

Subsoiled garden. Tomatoes averaged 10 oz. in weight, against 6 oz. for the unsubsoiled tomatoes. Vines bloomed until frost.

L. Z. LAWRENCE,
Haddonfield, N. J.

"The peas on the subsoiled plot were twice the size of the others, and very noticeable to passersby."

E. L. HARRIS,
Lewisburg, N. C.

Subsoiling for cantaloupes tremendous success.

W. L. GRAY,
Bridgeville, Del.

Subsoiled plot 60 x 100 ft. After a family of four had all the potatoes they wanted during the summer, I dug the balance of the patch and had 18 bushels of good, big potatoes. Two years before subsoiling he got 8 bushels of potatoes; a year before subsoiling got 4½ bushels.

DAVID J. FOX,
Edgemoor, Del.

Plot where subsoiling was done showed decided improvement in yield of Irish potatoes over field not subsoiled. Field now in cow peas; growth much heavier where subsoiling was done.

S. T. EASTABROOK & SONS,
Ponchatoula, La.

Yield of lima beans and tomatoes on subsoiled land was four times greater than on ground not subsoiled.

L. D. THOMAS,
Baltimore, Md.

Was very late getting subsoiled land planted to potatoes, "but they are in every way equal to potatoes planted 3 weeks earlier without blasting."

JOHN BJORNE,
Brule, Wis.

Miscellaneous

Before subsoiling "yielded practically nothing." After subsoiling 5.97 acres got 10,372 tons of beets, as compared with 11,629 tons from the same size plot, which strip "was of distinctly better quality and did not need subsoiling to break up the hardpan."

GREAT WESTERN SUGAR CO.,
Sterling, Colo.

The Sugar Company is more than delighted with this wonderful showing, and state they expect to get even better results next year.

Subsoiled about 2 acres. This corrected the drainage and "I made $250 worth of tobacco per acre. I followed this with wheat and made 35 to 40 bushels, and followed this with clover and made 3 tons per acre." The land was worth but $25 an acre before subsoiling.

F. A. TINGLEY,
Wellsville, Va.

Used Red Cross explosives for subsoiling to correct drainage. Before shooting could not be planted to any crop; now any Montana crop will grow on it.

BILLINGS GREENHOUSE CO.,
Billings, Mont.

Used Red Cross explosives for subsoiling to correct drainage in 35-acre field; materials cost $47. Put field in productive state and increased value of the land.

W. J. SNODDY,
Billings, Mont.

Subsoiled one-half acre. "It made a difference of at least 30 per cent."

CHARLES P. GREENWOOD,
Coatesville, Pa.

The Use of Lime

In improving and reclaiming farm lands the use of lime must always be kept in mind, because it plays such an important part in the upbuilding processes.

In the reduction of tight, sticky clays to a well-granulated condition, the effect of generous applications of lime are quite noticeable, in that the fine, unmanageable clay particles are drawn together into crumbs or granules.

Lime sweetens the sour soils and permits a better growth of the leguminous green manure crops so much needed to supply humus. An increase in humus means that the soils can be more easily drained, will absorb more moisture, and, best of all, will produce more crop.

Another beneficial effect from lime is that it increases the activities of beneficial bacteria in the soil. Many of the most helpful forms will not grow in a sour soil, and may be replaced by harmful forms.

Write to your State experiment station for printed matter describing how and when to use the different forms of lime, and begin at the first opportunity the needed work of sweetening and otherwise improving the soil.

Experience in Terracing

From "St. Louis Star Farmer," February 23, 1912.

Editor, "The Weekly Star Farmer":

Land that was washed down the hill, down the branch and down the river is gone, and gone forever. Wherever the top soil is thin and sandy, a tight clay lying close to the surface and the country hilly or rolling, washing is sure to follow. The precious and friendly raindrops, like fire, are a good servant, but a bad master. If allowed to wash away all the top soil, with its plain food, they become man's worst enemy.

In the four years I have occupied my present place I have not suffered the loss of one foot of top soil from washing, and my land is hilly. I solved the problem with Red Cross. At the same time I solved several other vastly important problems—the conservation of moisture, destruction of insects, and fine, porous pulverizing of soil for cultivation.

It is terracing with Red Cross that we are now considering. To do this, make a land level of three pieces of scantling or any cheap, rough, straight-edged stuff; one for your bench to be 8 to 12 feet long and two pieces of equal length 2½ to 3½ feet long. At a hardware store buy a 75-cent carpenter's spirit level. Secure it on top of bench in the middle by ten-penny nails partly driven. A more simple and accurate device could not be imagined; but if you prefer, buy a land level for $10 or $15. Two men can level fifty or more acres a day. One takes the level and one follows with a hoe, chopping out a hoeful of dirt at each end, thus indicating your terraces. Or a man may follow with turn plow or twister, discarding hoe. Throw several deep furrows up for terrace. Now, with a number of 1½-inch iron drills follow the last furrow and drill holes 24 to 34 inches deep, every 10 to 14 feet. Insert a half stick of Red Cross, equipped with cap and fuse. Tamp well with an old broom handle or other wood tamp, light at first and gradually harder and harder till hole is filled. Use clay for tamping. Split end of fuse to effect a powderpan; turn back and light a row at a time with a torch or matches. Use your best judgment in spacing terraces, according to steepness of your grade. Much land may be saved for cultivation by blasting close terraces alone, and only throwing every third or fourth one up with plow. It is marvelous how this will hold hilly land together. Save your fresh land and reclaim that which has begun to wash. Besides being the best means for terracing, you will literally irrigate your farm with these storehouses of moisture and will be astonished beyond measure at the ease of cultivation and crop returns.

I travel all over the Southern states from time to time, meeting nurserymen and orchardists. I have never yet seen a man who had used Red Cross explosives for stump blowing, tree setting, subsoiling or ditching who was disappointed with results. For my part, I use it for all these purposes on my place. It has more than proven its worth.

ARTHUR E. COLE.

High Point Farm and Nursery, DeKalb Co., Ga.

Blasting in the Orchard

A Proven Proposition

In 1910 the Du Pont Powder Company began to promote the use of explosives in planting new orchards and rejuvenating old ones. The idea was not original with us.

Nearly a quarter century ago, near La Mesa, Cal., ground was blasted for tree planting, because the orchardist found the work of planting with the spade in his resistant soil too difficult. His experiment was a success. The trees lived, thrived and bore exceptional apple yields for many years.

Other orchardists and farmers in other sections of the country also thought of the same scheme for preparing a home for the tree roots. We have records of such plantings, eleven, sixteen and twenty years ago, before the idea really began to spread.

After we began to advertise it extensively and sent out demonstrators throughout the country, many farmers and orchardists tried the new plan on a small scale. Now, because of the universal success of correct blasting for orchard planting, the majority of fruit trees are being planted in blasted ground.

There remains but three classes of fruit growers who still stick to the old methods:

1. Those whom we have not yet reached through our promotion efforts.

2. Those who have tried planting trees in blasted soil without knowing how to do it and hence failed to get satisfactory results, and

3. The class of farmers, orchardists and horticulturists who decry anything that is new, or which is being promoted by a business concern.

Millions of fruit, nut and shade trees have been planted in blasted ground, long enough to prove the great advantages of the method. America's leading orchardists and nurserymen now plant exclusively in blasted ground.

No one can afford to plant trees by any other method except in soil that is loose and sandy to a depth of five or six feet. In such soil blasting is not advantageous except for the elimination of fungus and nematoid troubles.

SIX-YEAR-OLD MAPLE IN BLASTED HOLE

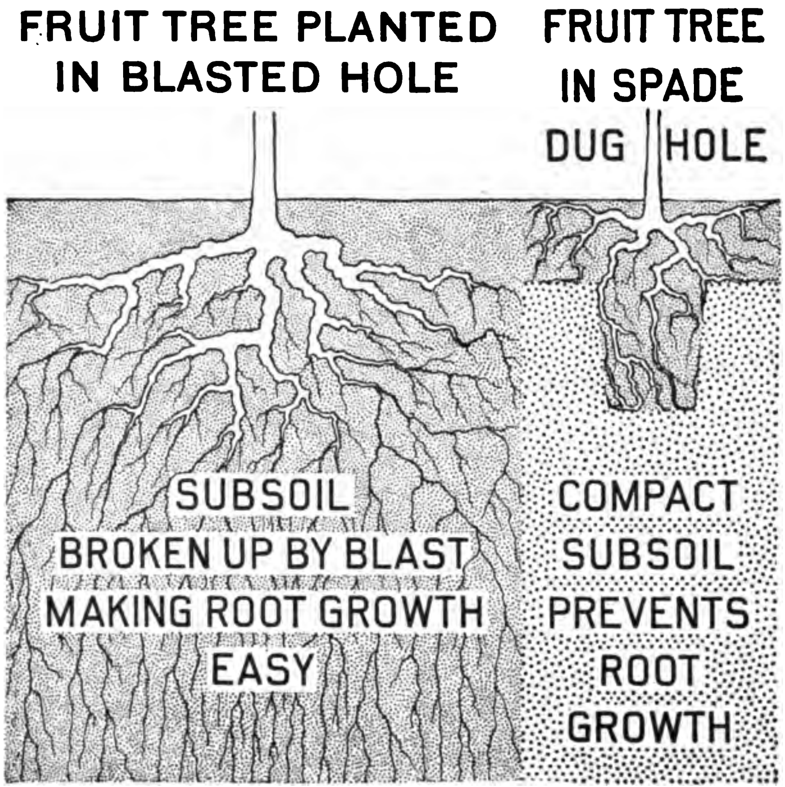

FRUIT TREE PLANTED IN BLASTED HOLE
FRUIT TREE IN SPADE DUG HOLE
SUBSOIL BROKEN UP BY BLAST MAKING ROOT GROWTH EASY
COMPACT SUBSOIL PREVENTS ROOT GROWTH

DIAGRAM OF SOIL SECTION AND ROOT GROWTH

What Blasting in Orchards Accomplishes

1. It mellows the ground to a depth of five or six feet and throughout a circular area ten to twenty feet in diameter, making it easy to dig the hole and plant the tree correctly.

2. It creates a porous, water-absorbing condition in the subsoil that makes the tree drouth-proof, stopping the big, first year loss.

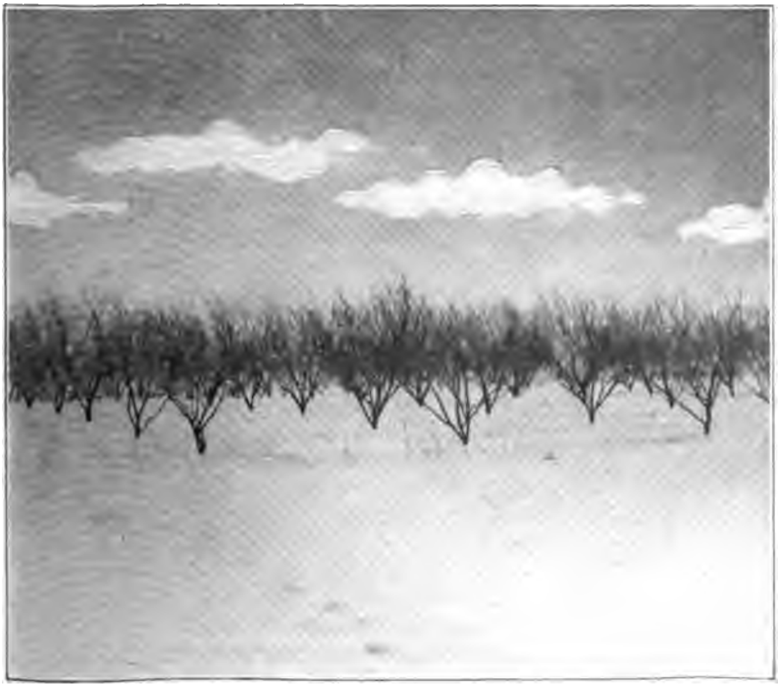
3. It makes root growth easy and makes tons per acre of new plant food available, hence speeds up the growth of the tree and makes it fruit one to two years earlier.

4. It creates drainage and prevents stagnation of water on surface.

5. In old orchards that were planted by the old methods and have ceased to bear well, it is of great value in rejuvenating the old trees, causing them to yield heavily.

6. It destroys fungus, nematode, and other orchard soil diseases, hence makes it possible to plant new orchards where old ones have been removed without waiting several years to rest the land and get rid of the diseases.

7. At a cost little or no more than of old-style planting, it causes at least a year's earlier return on the investment in new orchards, and greatly increased returns thereafter as compared with spade-set orchards.



PROFITABLE ORCHARD NEAR ROANOKE, VA.,
SET IN BLASTED SOIL

Planting a Tree for Keeps

In studying comparative costs of planting fruit trees, the investigator is confronted with widely varying figures and methods.

There seems to be no machine for planting fruit trees such as a corn drill, but the method of some planters approximates the work of a machine in speed, if not in efficiency.

They lay off the site of the proposed orchard in 20-ft. to 40-ft. checks, depending on the kind of trees to be planted. Cross furrows are plowed through the field, marking it off in squares.

One man drives along a furrow with a wagon-load of trees, another lays a tree near each of the furrow intersections, and a third stands the tree in the intersections, kicks some soil over the roots, tramps it down, and moves on to the next intersection. This method expresses a touching confidence in Nature, but results indicate such confidence is misplaced.

A tree that survives such treatment must have as many lives as the proverbial cat, and if it lives, how many years must elapse before it bears any fruit? What grade of fruit can be expected from a tree aged and bent with the fight for existence before it saves strength enough to bear at all?

Going to the other extreme we find a horticulturist advising: "Forget you are about to plant a tree and imagine you are going to bury a horse and dig a hole accordingly. Remember you can only plant it once, and its health and growth, the age at which it begins to bear, and the quantity and quality of fruit borne, depend chiefly on the care and thoroughness used in planting it."

Up to a few years ago, the method followed by most good orchardists was to dig a hole seldom as much as 2 feet in diameter and 18 inches deep, then plant the tree in top soil or a mixture of top soil and subsoil. Under this system the loss the first year ran from 25 per cent. to 50 per cent., depending on soil and weather conditions.

Then tree planting with explosives was taken up by a few orchardists who realized the shortcomings of the ordinary methods, and the necessity of cutting down first year losses, and speeding fruition.

The first objections to the new method were largely financial. The cost of explosives, blasting cap, fuse and labor ran from 8c. to 15c. per hole, whereas trees could be planted with a spade for 3c. to 5c. per hole. The trouble with this comparison is that the work performed is not the same, hence costs should not be compared.

The question involved is, how soon does the planter want a return from his investment and how large a return? The only way to compare costs is to consider the profit sought and which is the cheaper way to get it.

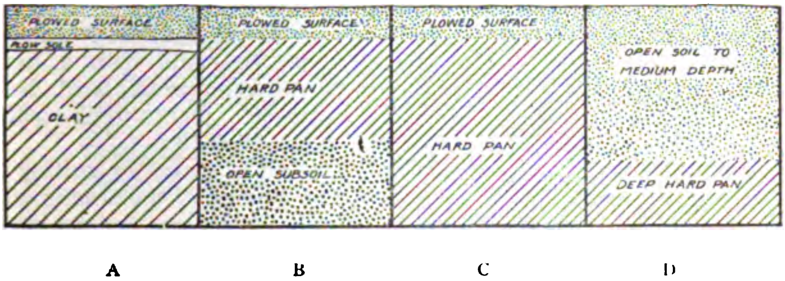
In the first place, the purpose of blasting is not to supplant the spade. It is possible to dig the hole with explosives, just as a hole may be excavated for a fence post. But the real object of blasting is to mellow the subsoil and make root growth and spade digging easy.

The places to set the trees or other plants being selected and marked by a stake, or better, if the field is large, by furrows plowed to indicate the exact lines for the trees, and crossed at the proper interval by other furrows to indicate the spacing in the rows. Sometimes a heavy cord or light wire stretched across the field will materially assist in laying out the orchard.

Blasting for tree planting is best done in the fall because it is easier to catch the subsoil in a dry condition, but blasting in the spring for spring planting, although the subsoil is apt to be wet or damp, is nevertheless much better than planting in dug holes. It should be done as many days ahead of planting as possible, to get the effect of air and sunlight in the hole.

The exact nature and depth of the subsoil should be known in order that the explosive may be used to the very best advantage. The only way to know this is to go down and see. Do not stop at the surface but go down four or more feet. Using a good soil auger is the best and easiest way to test out a subsoil, but if one cannot be had, dig a hole. Another way is to blast out a test hole and examine each layer of the soil. This is not so good as the other methods as the blast so disturbs the subsoil that it is hard to tell just what the original condition was.

There are many different stratifications of the subsoil, but those illustrated by the drawings are the most common. If the arrangement of the soil is like that in illustration "A," place the explosive well down into the clay and destroy any shallow plow sole with a good plow. The best depth for blasting in such soil is usually from thirty to thirty-six inches.



DIFFERENT TYPES OF HARDPAN ENCOUNTERED IN THE ORCHARD

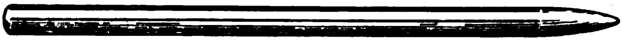
In soils like the one represented in "B," place the charge toward the bottom of the hardpan so that the entire stratum may be pulverized, but do not go below the bottom of it, as the force of the blast will tend to raise the hardpan in chunks rather than shatter it. The depth is governed absolutely by the depth of the hardpan.

Illustration "C," shows one of the most common subsoil troubles. This type of hardpan or tight clay is usually too deep to blast through and relief is obtained by pulverizing several feet of the top, which if well done will be found to be sufficient to store moisture and furnish room for an ample root development. For such a condition the blast should be made not less than three feet deep.

Occasionally a soil is found like that shown in "D," and will usually be found to require deeper blasting. The explosive should be placed well down in the hardpan—the deeper the better.

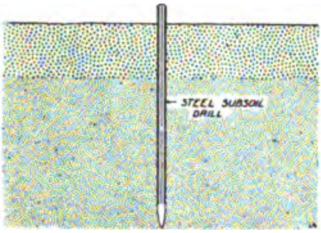
When very deep loading is practiced it is best to increase the amount of the charge, sometimes as much as double the amount normally used.

A number of different methods have been devised for making the bore holes for loading, but so far no other tool has given such good results as a heavy subsoil punch. This tool is made of 1½-inch steel and should be not less than three feet long. Smaller drills will not be satisfactory, as the explosive cartridge is itself 1¼ inches in diameter and when primed with cap and fuse is difficult to load into a smaller hole. The punch is driven to the desired depth, with a sledge, and loosened by pounding on the sides, after which it can easily be withdrawn.



PUNCH FOR MAKING THE HOLES

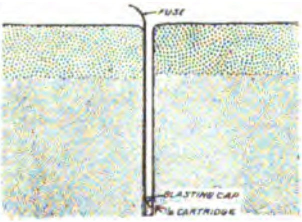
A soil auger is quite satisfactory for making a small number of holes, but is too slow and expensive if there is much work to be done. However, for holes deeper than three feet, one can be used very satistorily to deepen the drilled holes. In some cases holes can be made with a heavy crowbar. Some soils are so hard, being in reality soft rock, that a rock drill is required to make the holes.



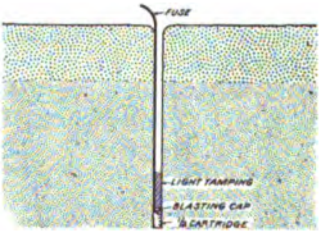
Punching the Hole

The charge is prepared by cutting off a piece of fuse as long as the hole is deep, and crimping a cap on one end by means of a cap crimper. The cap with the fuse attached is inserted into the explosive used, and securely tied.

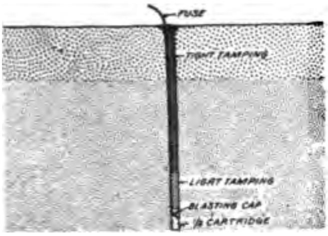
Start the charge into the bore hole and press it gently to the bottom with a wooden tamping stick. Pour in four or five inches of loose dirt and tamp it gently, then pour in more dirt, preferably slightly moist as



The Charge in Place



Loose Tamping Over Charge

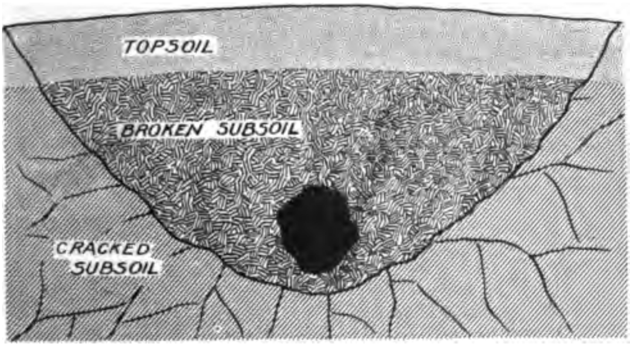


Top of Hole Tamped Tight

it packs better, and tamp firmly. When the explosive is covered with several inches of lightly packed soil the rest of the tamping should be made as hard and tight as is possible, using the stick in one hand. The hole should be tamped full.

The next operation is to light the fuse and retire to a sufficient distance to avoid any loose material that may be thrown out. If the loading is properly done and at a sufficient depth there is usually only a thud and a cracking at the surface and no soil is thrown into the air.

If the holes are blasted in advance of the time of setting the trees they are left without further attention until planting time, unless it is desirable to add some manure or fertilizer to be diffused through the soil. This is a good practice, especially on poor soil. If the soil is sour, sticky clay, a few pounds of lime scattered in the hole will materially assist in flocculating the clay and keeping it permanently granulated and sweet.



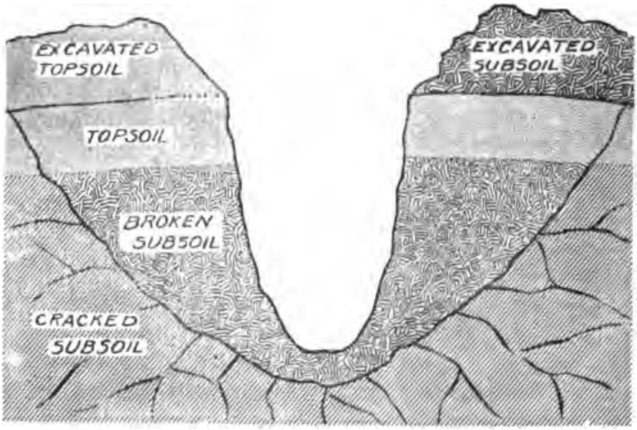
THE BLAST THOROUGHLY CRACKS THE SOIL, BUT USUALLY LEAVES A CAVITY OR POTHOLE AT THE BOTTOM. THIS MUST BE FILLED

When the trees are to be planted shovel out the hole and locate the cavity that is usually sprung at the bottom of the hole. Fill this with tamped soil to firm the base to prevent subsequent settling of the tree; fill the hole to the level it is desired to set the tree, being careful to keep the soil well tamped. Set the tree with the roots in as near their original position as possible and pack them with the top soil that has been shoveled out of the hole.

When no attention is paid to settling or firming the soil in the bottom of the hole, trouble often results from the tree settling too deep after the first heavy rains, but this trouble has never been observed when the holes were properly examined and the described precautions observed in setting the tree.

Just before packing the soil around the trees be sure that they are in line with the rest of the row.

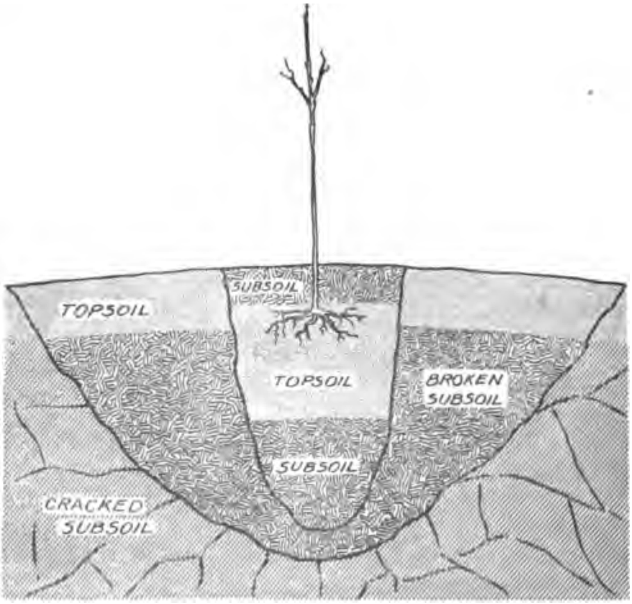
When trees are set as much as thirty or more feet apart it is an excellent practice to place blasts midway between the rows after the trees have been growing several years. These will open up the subsoil between the trees that was but slightly disturbed by the original blasts



THE BEST PRACTICE IS TO SHOVEL OUT THE LOOSE SOIL AND EXPOSE THE POTHOLE. THIS IS EASILY DONE IN THE FRESHLY BLASTED HOLES

and will induce more vigorous root growth, and consequently better trees will be the result.

It should be remembered that this method of resetting applies not only to orchard trees such as the apple and peach, but to nut trees, shade trees, berries, vines, roses and all classes of ornamental and commercial trees and shrubs, and is proving a money saver as well as a money maker.



AS MUCH OF THE HOLE AS POSSIBLE SHOULD BE FILLED WITH RICH TOP SOIL. PACK THIS ENOUGH TO PREVENT SETTLING AND SET THE ROOTS LIKE THEY WERE IN THE NURSERY

The Verdict of Practical Experts

The true test of the value of any agricultural or horticultural theory is in commercial rather than experimental trials. The commercial orchardist or nurseryman adopts a new method not out of scientific interest, but because it pays.

Many theories seemingly proved sound in experiment station tests fail to stand up under the varying conditions of actual farming or orcharding. And likewise technical instructors and scientific investigators sometimes fail to recognize the merit of a new method until long after it has been adopted with success by the men who really lead in the industry or art.

Thus, there are still some pomologists and soil physicists who are either skeptical as to the value of blasting orchard land, or actually deny its value. We do not question the sincerity of these gentlemen. Instead, we respectfully direct their attention to the overwhelming evidence of those who have to know as printed in this booklet.

To obtain incontrovertible proof that would turn opponents to advocates, we wrote America's leading commercial orchardists and nurserymen, asking them to answer the following questions:

1. For how long and to what extent have you been engaged in fruit culture?

   (The idea of this question is to show what weight may be attached to your opinion.)

2. In what year did you first use explosives in tree planting?

3. What effect do you observe on the percentage of first year losses of trees set with Red Cross as compared with those set in dug holes?

4. What difference in growth have you noted as between trees set in blasted and in spade-dug holes?

5. What differences in the general health of the tree?

6. What differences in the time of maturity and fruition?

7. What difference in the quantity and quality of fruit?

8. From a financial point of view, what are the advantages of blasting?

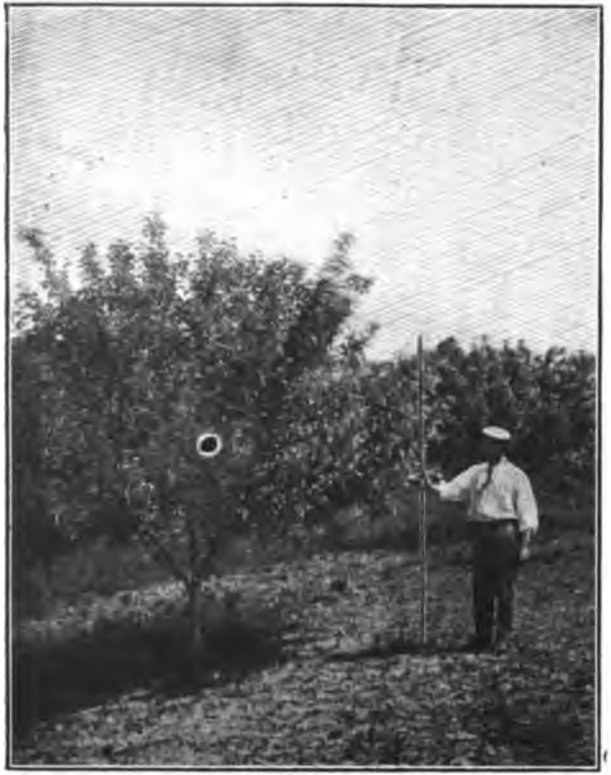
9. What effect has the use of explosives in tree planting on the conservation of moisture in the subsoil and in resistance to drouth?

Have we permission to publish your replies?

We suggest that you write your replies on your regular business letterhead so we may make a facsimile reproduction of same in a neat booklet. It will not be necessary to repeat the questions in your letter, but simply give the numbers and your replies, as we will repeat in the booklet the list of questions asked.

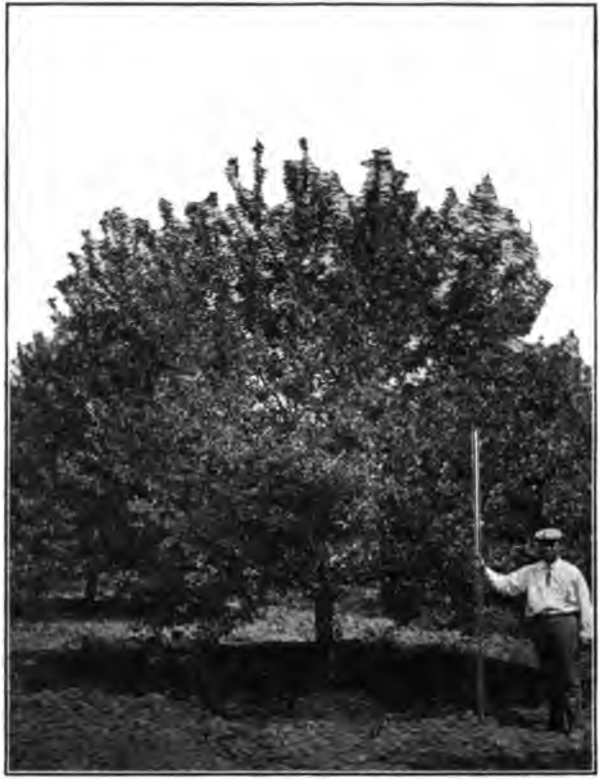
Their answers on their own letterheads were photographed and are reproduced in this booklet. Read every one. If you are at all interested in fruit culture, you will be as enthusiastic about orchard blasting as we are.

ROSE CLIFF FRUIT FARM



NOT BLASTED

Nine-year-old apple tree planted in ordinary manner with shovel, same variety and age as tree in opposite cut and not 200 feet away, same soil. Apple trees planted 30 feet apart on square system.



BLASTED

Nine-year-old apple tree planted in ground shattered with ½ cartridge 40% dynamite placed at depth of 18 inches. Apple trees planted 30 feet apart on square system.

FLEW FISHBURNE, V-PRES.

ROSE CLIFF CHAMPAGNE CIDER AND APPLE VINEGAR
MADE FROM THE PURE JUICE OF THE APPLE

L. MEHLER, SEC.-TREAS.

Rose Cliff Fruit Farm, Inc.
JAS. CRAIG, PRES. AND GEN.-MGR.

GROWERS AND SHIPPERS OF
APPLES AND BERRIES

PURE APPLE CIDER, VINEGAR, CANNED
TOMATOES, APPLES AND APPLE BUTTER

WAYNESBORO, VA. June 3, 1914

Mr. George Frank Lord,
c/O DuPont Powder Co.,
Wilmington, Del.

Dear Mr. Lord:

In reply to your nine questions beg to state that we will answer them in series as requested.

1. I have been in the fruit culture twenty one years.
2. We used dynamite first in 1899
3. The percentage of loss of trees planted with dynamite is great deal less. I would say 400% less.
4. Trees planted with dynamite obtain a growth of 1/3 to 1/2 more on an average.
5. The health of the tree is quite perceptive. Foliage being greener and much larger.
6. The difference in the fruiting period is practically none.
7. The quality of the fruit seems to be better and the color is much better.
8. From the financial stand-point it is hard to compute the value and difference between dynamited and undynamited trees except to say that it is a very valuable proposition, and I would not think of setting out trees without dynamite if it cost me $50.00 per acre extra.
9. The conservation of moisture in the soil and subsoil by using dynamite is very perceptible, it retains the moisture must longer and holds the superfluous moisture from the hard pan under the subsoil and prevents a disease caused from too much water which is very common in wet soil, and what is termed wet feet.

You have our permission to publish any or all of these reports, and take pleasure in giving them to you from the fact that you are doing a valuable work in having people use dynamite in orchards and work along the line of improved agriculture.

With best wishes, I remain,
Yours very truly,

ROSE CLIFF FRUIT FARM, INC.

James Craig

HALE GEORGIA ORCHARD CO. BLOCK OF THREE-YEAR-OLD PEACHES. SEVEN ROWS AT LEFT NOT BLASTED. REST OF ORCHARD, BEGINNING AT RIGHT, BLASTED AND SHOWS 50% MORE FRUIT AND GROWTH

HALE GEORGIA ORCHARD CO. PEACHES, SECOND SEASON'S GROWTH. ALL SET IN BLASTED HOLES

HALE GEORGIA ORCHARD CO. FOUR-YEAR-OLD ELBERTA PEACHES. ROW AT RIGHT BLASTED. GROWTH FULLY 50% MORE THAN THE UNBLASTED ROWS

[illegible]

[illegible]

HALES FRUITS

HALE GEORGIA ORCHARD CO.

EDGEWOOD FARM
LARGEST PEACH ORCHARD IN THE WORLD.

FORT VALLEY, GA. July 9, 1914.

E. I. du Pont de Nemours Powder Co.,
Wilmington, Delaware.

Gentlemen:

Replying to your letter of inquiry of May 28th with regard to the use of dynamite for tree planting, I take pleasure in offering the following observations made on the peach lands of Georgia:

I have been in the orchard business for 25 years and first used dynamite for tree planting on an experimental scale in 1909. During the following year, I blasted 4000 holes on a commercial scale and compared the results as before with trees in unblasted or spade dug holes. The results were that there was a loss of only 2% of trees set in blasted holes and a loss of 50% of the trees set in spade dug holes. Since then on this orchard, we make a practice of setting our young trees only in dynamited holes.

Aside from the benefits in decreasing the death rate of young trees, blasting has resulted in increasing the growth of the young trees as much as 40 to 60% as compared with trees set by the ordinary methods. The vigor of the trees set in this manner has been very marked and the quantity of the fruit produced has been increased very remarkably and we are this year making a careful study of the comparative yields.

From the financial standpoint, the use of dynamite has been very profitable to us. Much of this work has been carried on during very dry seasons but the trees planted on blasted ground retained their color and continued to grow even during the very driest months so it is quite evident that the result of the subsoil shattering was to increase storage of subsoil moisture so that it would tide the trees over the seasons of deficient rain fall.

It was on blasted soil that we perfected the famous Hale peaches.

One block of trees which were bearing poorly on account of nematoids was thoroughly blasted with the result that they put on a very vigorous growth almost immediately and the following season bore a satisfactory and profitable crop.

We find, after a large amount of experimentation, that in setting re-plants and re-setting an old orchard, we got an almost total loss of young trees from disease when the holes were plowed or dug with a spade but when these holes are blasted, the young trees grow as well as on virgin soil.

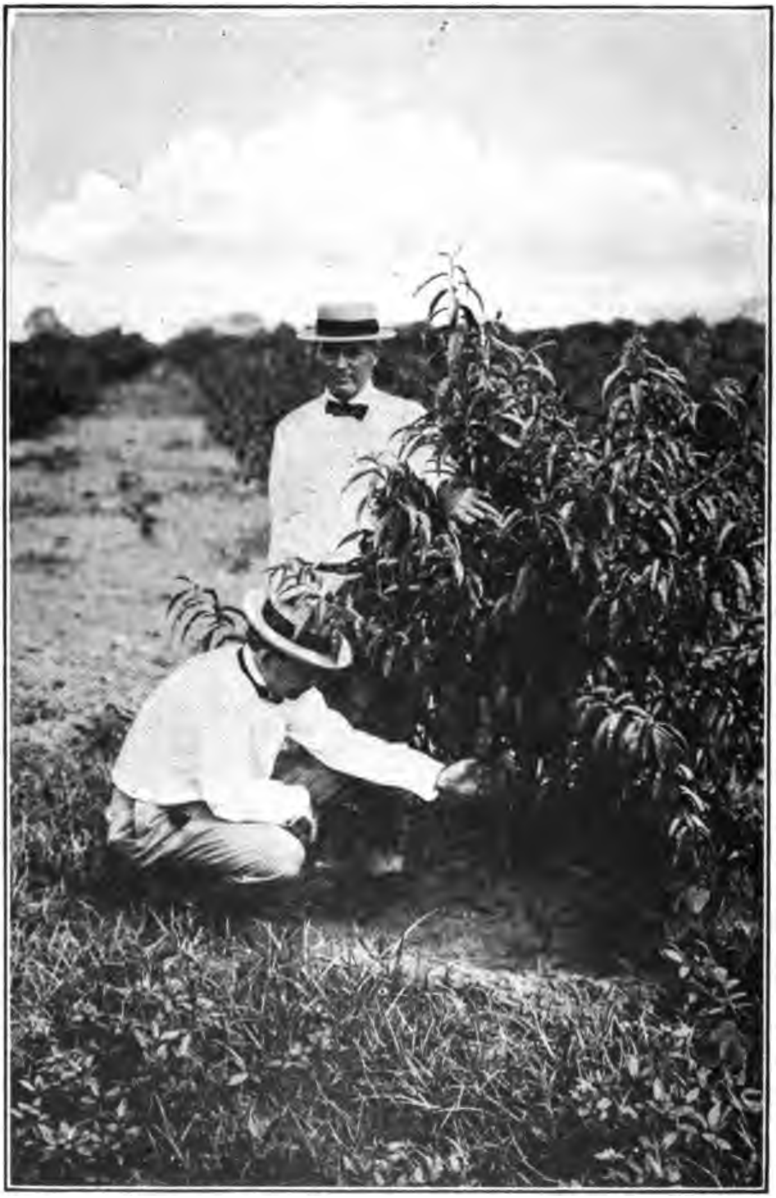
Dynamite has been of great assistance to us in controlling our most harmful plant diseases.

You have my permission to publish this statement of results obtained in the Hale orchards, or extracts therefrom.

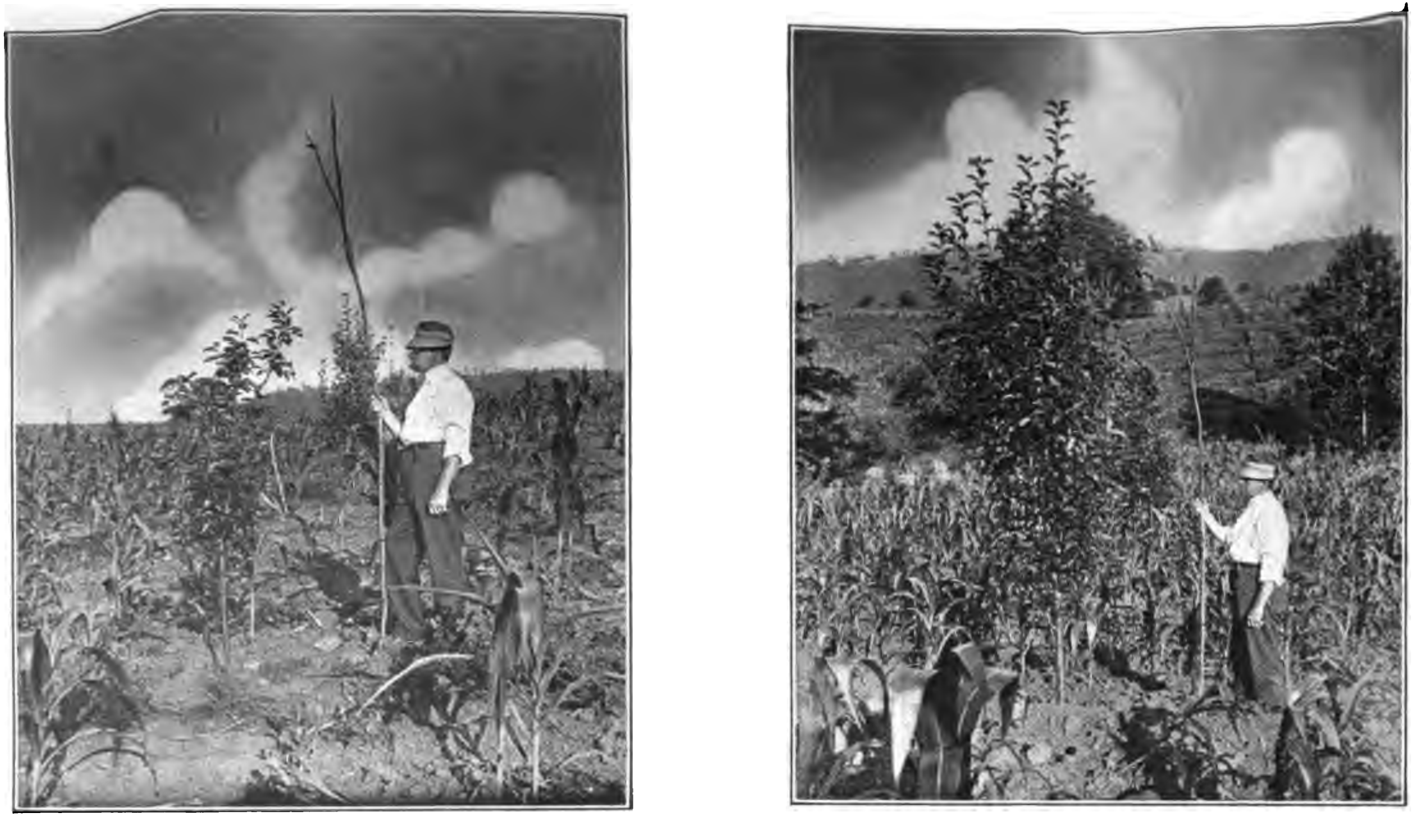
Very truly yours,

John D. Baird

SUPERINTENDENT,
HALE GEORGIA ORCHARD CO.

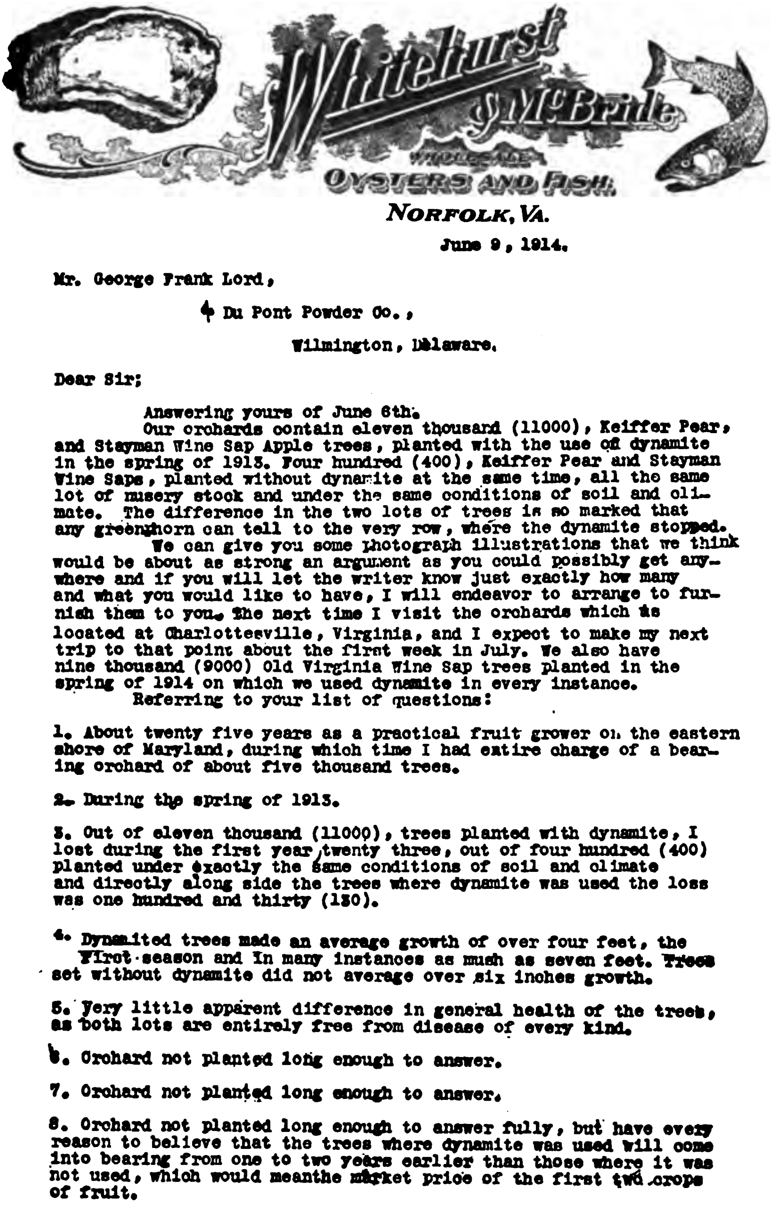


HALE GEORGIA ORCHARD CO. ONE-YEAR-OLD PEACH SET IN BLASTED GROUND. ALL GROWTH ABOVE THUMB OF STOOPING MAN MADE IN ONE SEASON



PLANTED WITHOUT BLASTING PLANTED IN BLASTED GROUND

Whitehurst & McBride Pear Orchard Showing Two Trees Planted in Spring of 1913. Photo graphed about August 1, 1914.



Whitehurst & McBride
WHOLESALE
OYSTERS AND FISH.
NORFOLK, VA.

June 9, 1914.

Mr. George Frank Lord,
c/o Du Pont Powder Co.,
Wilmington, Delaware.

Dear Sir;

Answering yours of June 6th.

Our orchards contain eleven thousand (11000), Keiffer Pear, and Stayman Wine Sap Apple trees, planted with the use of dynamite in the spring of 1913. Four hundred (400), Keiffer Pear and Stayman Wine Saps, planted without dynamite at the same time, all the same lot of nusery stock and under the same conditions of soil and climate. The difference in the two lots of trees is so marked that any greenhorn can tell to the very row, where the dynamite stopped.

We can give you some photograph illustrations that we think would be about as strong an argument as you could possibly get anywhere and if you will let the writer know just exactly how many and what you would like to have, I will endeavor to arrange to furnish them to you. The next time I visit the orchards which is located at Charlottesville, Virginia, and I expect to make my next trip to that point about the first week in July. We also have nine thousand (9000) Old Virginia Wine Sap trees planted in the spring of 1914 on which we used dynamite in every instance.

Referring to your list of questions:

1. About twenty five years as a practical fruit grower on the eastern shore of Maryland, during which time I had entire charge of a bearing orchard of about five thousand trees.

2. During the spring of 1913.

3. Out of eleven thousand (11000), trees planted with dynamite, I lost during the first year, twenty three, out of four hundred (400) planted under exactly the same conditions of soil and climate and directly along side the trees where dynamite was used the loss was one hundred and thirty (130).

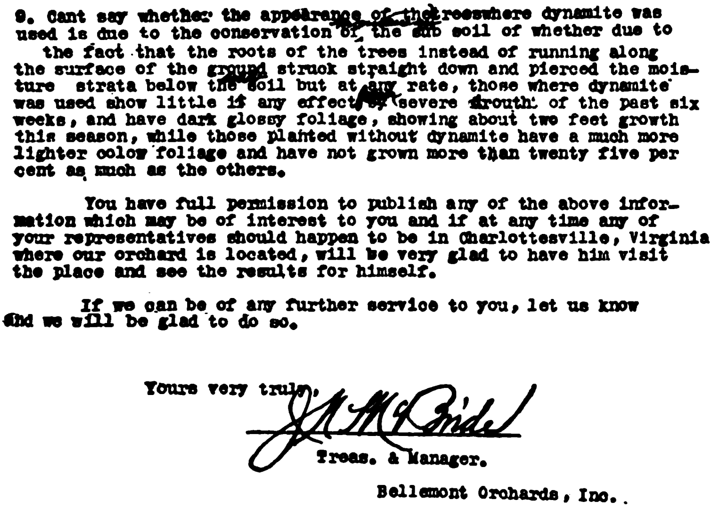
4. Dynamited trees made an average growth of over four feet, the first season and in many instances as much as seven feet. Trees set without dynamite did not average over six inches growth.

5. Very little apparent difference in general health of the trees, as both lots are entirely free from disease of every kind.

6. Orchard not planted long enough to answer.

7. Orchard not planted long enough to answer.

8. Orchard not planted long enough to answer fully, but have every reason to believe that the trees where dynamite was used will come into bearing from one to two years earlier than those where it was not used, which would meanthe market price of the first two crops of fruit.



9. Cant say whether the appearance of the trees where dynamite was used is due to the conservation of the sub soil of whether due to the fact that the roots of the trees instead of running along the surface of the ground struck straight down and pierced the moisture strata below the soil but at any rate, those where dynamite was used show little if any effect of severe drouth of the past six weeks, and have dark glossy foliage, showing about two feet growth this season, while those planted without dynamite have a much more lighter color foliage and have not grown more than twenty five per cent as much as the others.

You have full permission to publish any of the above information which may be of interest to you and if at any time any of your representatives should happen to be in Charlottesville, Virginia, where our orchard is located, will be very glad to have him visit the place and see the results for himself.

If we can be of any further service to you, let us know and we will be glad to do so.

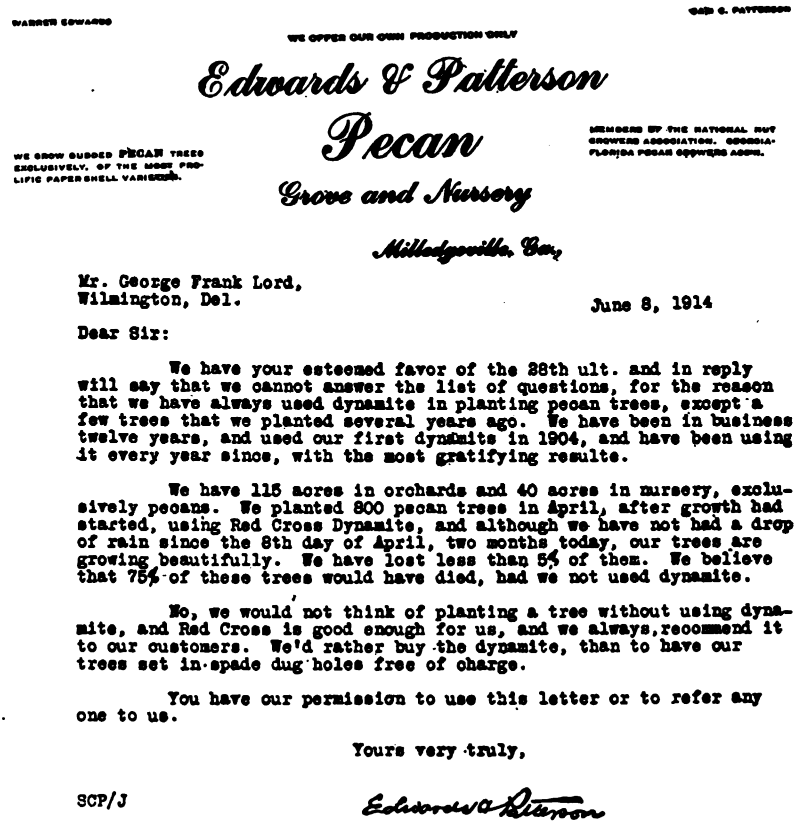
Yours very truly,

J. A. McBride

Treas. & Manager.

Bellemont Orchards, Inc.

EDWARDS & PATTERSON PECAN GROVE. ALL TREES SET IN BLASTED GROUND



WARREN EDWARDS

SAM C. PATTERSON

WE OFFER OUR OWN PRODUCTION ONLY

Edwards & Patterson
Pecan
Grove and Nursery

WE GROW BUDDED PECAN TREES EXCLUSIVELY, OF THE MOST PROLIFIC PAPER SHELL VARIETIES.

MEMBERS OF THE NATIONAL NUT GROWERS ASSOCIATION. GEORGIA-FLORIDA PECAN GROWERS ASS'N.

Milledgeville, Ga.,

Mr. George Frank Lord,
Wilmington, Del.

June 8, 1914

Dear Sir:

We have your esteemed favor of the 28th ult. and in reply will say that we cannot answer the list of questions, for the reason that we have always used dynamite in planting pecan trees, except a few trees that we planted several years ago. We have been in business twelve years, and used our first dynamite in 1904, and have been using it every year since, with the most gratifying results.

We have 115 acres in orchards and 40 acres in nursery, exclusively pecans. We planted 800 pecan trees in April, after growth had started, using Red Cross Dynamite, and although we have not had a drop of rain since the 8th day of April, two months today, our trees are growing beautifully. We have lost less than 5% of them. We believe that 75% of these trees would have died, had we not used dynamite.

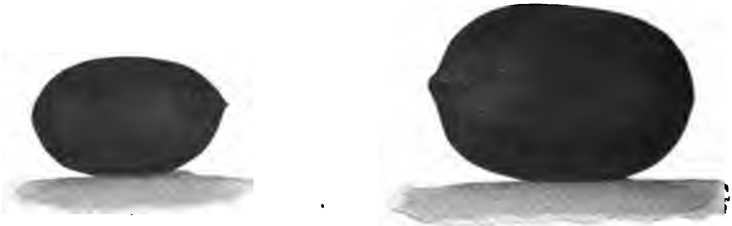
No, we would not think of planting a tree without using dynamite, and Red Cross is good enough for us, and we always recommend it to our customers. We'd rather buy the dynamite, than to have our trees set in spade dug holes free of charge.

You have our permission to use this letter or to refer any one to us.

Yours very truly,

SCP/J

Edwards & Patterson



EDWARDS & PATTERSON PECANS, ACTUAL SIZE, SENT TO US AS FAIR AVERAGE SAMPLES OF NUTS GROWN ON UNBLASTED AND BLASTED TREES, THE NUT TO THE RIGHT BEING FROM A TREE SET IN BLASTED GROUND

JAMES CRAIG, PRESIDENT
[illegible], VICE-PRES.
[illegible], SECRETARY

OWNERS OF 2000
ACRES OF THE BEST
FRUIT LAND IN VIRGINIA

SHENANDOAH VALLEY APPLE LANDS CO., INC.

OFFICE: FIRST NATIONAL BANK BUILDING

WAYNESBORO, VIRGINIA May 20, 1914.

Mr. George Frank Lord, Mgr.
Agricultural Division,
Wilmington, Del.

Dear Sir:

REPORT ON TREE PLANTING WITH DYNAMITE.

No. 1.- I have been closely identified with commercial apple orchards for ten years and directed and supervised the planting of some 750 acres on the Blue Ridge Mountains in land with a stiff clay subsoil.

No. 2.- My associates started using dynamite in 1902 and I have continued the practice and have been closely following the results for some seven years.

No. 3.- During the dryest years we have planted, 97% to 100% of our dynamited trees lived as against 75% dug hole trees. One thirty acre orchard planted with a half stick of 20% dynamite to each tree hole shows a loss at the end of the first year of but two trees. We figure that even in favorable seasons more than 10% of trees will die in dug holes.

No. 4.- The difference in growth is 60% to 75% better in dynamited holes. I trust the dynamite every time because in ~~[illegible]~~ May and June I get a rapid growth which enables me to shape the head early the first growing season.

No. 5.- The general health of the dynamited planted tree is uniformly vigorous.

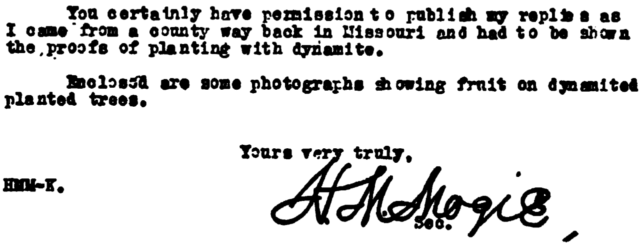
No. 6.- Our varieties fruit one to two years earlier. from dynamited holes but the fruit wood is so vigorous and strong that we really get in the money crops three years earlier.

No. 7.- Dynamited planting wins out in both quality and quantity of fruit.

No. 8.- From a financial view point dynamiting tree holes saves from $6 to $8. an acre and there is always a valuable saving in time of planting.

No. 9.- Dynamited tree planting is drought insurance. I walked

through a young orchard this morning planted on a rocky hill side that several orchardists said would not grow trees that your expert, Baskerville, dynamited for me and the trees so far this year have made a twenty-four inch growth -- across the fence are some dug hole trees that have not grown more than six inches this season.



You certainly have permission to publish my replies as I came from a county way back in Missouri and had to be shown the proofs of planting with dynamite.

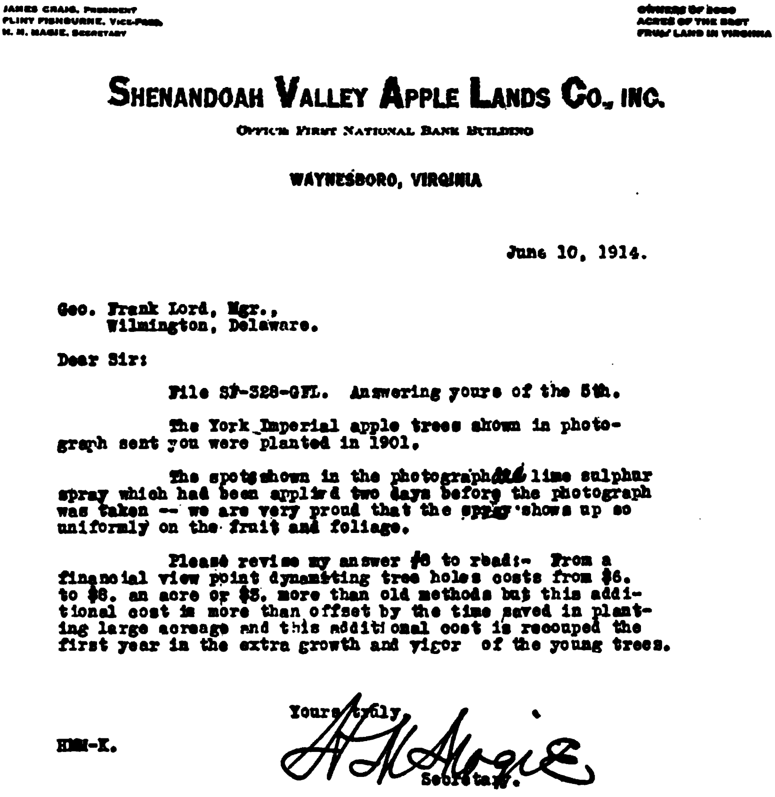
Enclosed are some photographs showing fruit on dynamited planted trees.

Yours very truly,

HMM-K.

H. M. Magie
Sec.

NOTE.—Fearing that the spotted appearance of the apples in the photographs sent by Mr. Magie might occasion adverse comment, we wrote asking him to explain the cause. He replied as follows:



JAMES CRAIG, PRESIDENT
PLINY FISHBURNE, VICE-PRES.
H. M. MAGIE, SECRETARY

OWNERS OF 5000
ACRES OF THE BEST
FRUIT LAND IN VIRGINIA

SHENANDOAH VALLEY APPLE LANDS CO., INC.

OFFICE: FIRST NATIONAL BANK BUILDING

WAYNESBORO, VIRGINIA

June 10, 1914.

Geo. Frank Lord, Mgr.,
Wilmington, Delaware.

Dear Sir:

File SF-328-GFL. Answering yours of the 5th.

The York Imperial apple trees shown in photograph sent you were planted in 1901.

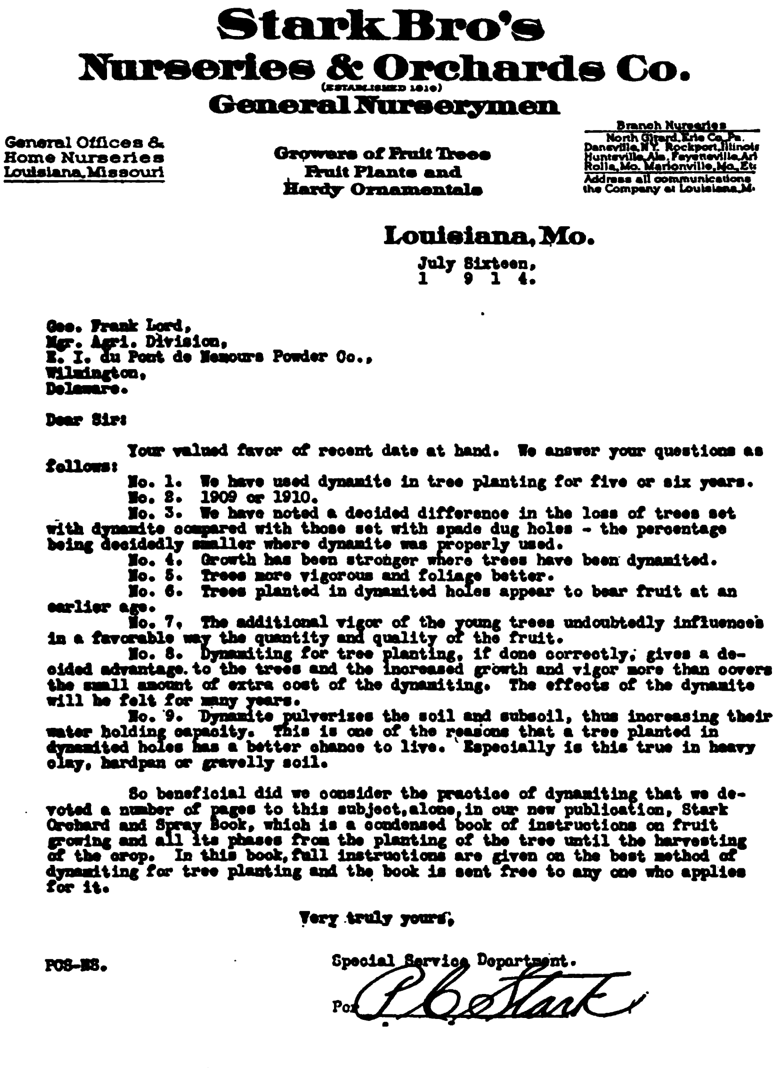
The spots shown in the photograph are lime sulphur spray which had been applied two days before the photograph was taken -- we are very proud that the spray shows up so uniformly on the fruit and foliage.

Please revise my answer #8 to read:- From a financial view point dynamiting tree holes costs from $6. to $8. an acre or $3. more than old methods but this additional cost is more than offset by the time saved in planting large acreage and this additional cost is recouped the first year in the extra growth and vigor of the young trees.

Yours truly,

HMM-K.

H. M. Magie
Secretary.



Stark Bro's
Nurseries & Orchards Co.
(ESTABLISHED 1816)
General Nurserymen

General Offices &
Home Nurseries
Louisiana, Missouri

Growers of Fruit Trees
Fruit Plants and
Hardy Ornamentals

Branch Nurseries
North Girard, Erie Co., Pa.
Dansville, N.Y. Rockport, Illinois
Huntsville, Ala. Fayetteville, Ark
Rolla, Mo. Marionville, Mo., Etc
Address all communications
the Company at Louisiana, M.

Louisiana, Mo.

July Sixteen,
1 9 1 4.

Geo. Frank Lord,
Mgr. Agri. Division,
E. I. du Pont de Nemours Powder Co.,
Wilmington,
Delaware.

Dear Sir:

Your valued favor of recent date at hand. We answer your questions as follows:

No. 1. We have used dynamite in tree planting for five or six years.

No. 2. 1909 or 1910.

No. 3. We have noted a decided difference in the loss of trees set with dynamite compared with those set with spade dug holes - the percentage being decidedly smaller where dynamite was properly used.

No. 4. Growth has been stronger where trees have been dynamited.

No. 5. Trees more vigorous and foliage better.

No. 6. Trees planted in dynamited holes appear to bear fruit at an earlier age.

No. 7. The additional vigor of the young trees undoubtedly influences in a favorable way the quantity and quality of the fruit.

No. 8. Dynamiting for tree planting, if done correctly, gives a decided advantage to the trees and the increased growth and vigor more than covers the small amount of extra cost of the dynamiting. The effects of the dynamite will be felt for many years.

No. 9. Dynamite pulverizes the soil and subsoil, thus increasing their water holding capacity. This is one of the reasons that a tree planted in dynamited holes has a better chance to live. Especially is this true in heavy clay, hardpan or gravelly soil.

So beneficial did we consider the practice of dynamiting that we devoted a number of pages to this subject, alone, in our new publication, Stark Orchard and Spray Book, which is a condensed book of instructions on fruit growing and all its phases from the planting of the tree until the harvesting of the crop. In this book, full instructions are given on the best method of dynamiting for tree planting and the book is sent free to any one who applies for it.

Very truly yours,

POS-MS.

Special Service Department.
Per P. C. Stark

Address all communications to the Company-not to individuals

NOTE.—The book which Stark Bros., issue free to orchardists, entitled, "Stark Orchard and Spray Book," is well worth getting.

Harrison Brothers Endorse Blasting

Harrison Brothers, with nurseries at Berlin, Md., have 4,000 acres, which contain more than 200,000 trees, and they are among the leading nurserymen of the East. They have prepared a very complete book entitled "How to Grow and Market Fruit," retailing at 50c. a copy, containing valuable information.

They say, "What is stated here is the most practical kind of hard-won knowledge, for it outlines 'how we do it' in fruit-culture."

From the chapter on "Methods of Keeping Moisture":

"Subsoiling with explosives is a thoroughly practical method, and should be employed on three-fourths of the farms of the East.

"By far the best way to loosen subsoil is with Red Cross. This is not generally known, but orchardists will find they can reduce tillage expenses greatly and save much time with it. The exploding of from a sixth to a half pound, two or three feet under the surface, loosens and makes fine all the soil. Young trees will make great strides if they are so planted.

"Blasting can be done in orchards or about trees of *any age*. If done rightly, it will accomplish the work without breaking or tearing away any roots, leaving the soil in condition to give the roots twice the feeding-ground they had before and providing perfect drainage and water-storing capacity. The use of explosives is the secret of success in growing fruit by mulching systems without so much plow and harrow tillage."

From the chapter on "Cultivation":

"It is necessary to break up the subsoil, whether there is hardpan or not. The Red Cross method usually is the cheapest at any time, and it is the only way by which the work can be done thoroughly after trees have been planted.

"Red Cross is the thing with which to dig holes for new trees, to break up the whole soil three or four feet deep every few years, and to help renovate old orchards, because it will do these things more cheaply and better than they can be done by any other means. If you have fruit trees, which seem to be standing still and which do not bear, no matter how big they are, properly explode a charge in the soil around or between them, and the trees will likely get to work. In a bearing orchard, a proper charge midway between trees is always safe and is generally very effective."

From the chapter on "When Trees Will Not Bear":

"Explode three or four charges of Red Cross a few feet away from each tree. Mulch the surface with a thick covering of vegetable matter, or by keeping a couple inches of dust under the tree. Feed with commercial fertilizer."

From the chapter on "Grapes":

"Vines are heavy feeders. Their roots extend far out and make a network in the soil. The proper distance to plant will be from six to eight feet apart, although sometimes this can be changed to advantage. Strong varieties, on fertile soil, need more room than small growers on poor soil. Before planting is done, the ground should be worked even more thoroughly and deeply than for a tree. Remember that you are planting something which will last a generation, not a crop to be removed in a season or two. Plow the land, use explosives to dig the holes, and have a clearance inside the hole of at least twenty inches."

Blasting Restores Failing Orchards

1. Young spade-set trees can be forwarded in development at least a year by blasting between the rows.

2. Old, failing trees can be restored to ample productiveness by blasting between the rows.

3. Fungus diseases can be eliminated by blasting under affected trees, or blowing out those killed by fungus, and planting new trees in their places.

We frequently receive letters from orchardists stating that they had planted trees in their orchards a year, two years or three years ago which are not doing well because of hardpan conditions beneath the surface soil or because of compacted soil or insufficient moisture storage capacity of soil. These orchardists express the keenest regret at having learned about tree planting with explosives after their orchards had been planted. They tell us they believe their trees would be in a much better condition had they been planted by this method.

If their trees are alive, the subsoil in which the trees are planted can still be broken up by subsoil blasting between the trees. This rejuvenation work will give the trees almost the same favorable opportunity for growth and development that they would have had had they been planted in blasted holes in the first place.

Millions of fruit, shade and ornamental trees are standing in the orchards, parks, yards and along highways in this country. Many of them are very valuable because of the fruit they are capable of producing. Others are highly prized by their owners because they serve to ornament and shade residence properties or parks; others add greatly to the appearance of streets.

But many of these are in an unhealthy condition. If the soil in which the tree is planted is compacted so that it is difficult for the roots to make healthy growth into the deep subsoil or if the soil is not sufficiently porous to permit of the absorption and storage of moisture, blasting will prove an effective remedy.

In every part of the United States will be found trees in parks and along public highways showing signs of deterioration. Sometimes these conditions are due to the fact that the trees are planted in poor soil; sometimes because they are in soil underlaid with hardpan or compact subsoil; sometimes because their roots grow out under asphalt, cement or flag pavements which prevent them from obtaining the benefit of rainfall. In any of these cases the use of Red Cross will improve the health of the tree.

Blasting Around Growing Trees

You doubtless remember me telling you a few years ago about blasting around some pecan trees with dynamite and how they outgrew the others. I am sending you a photograph of one of these, taken two years ago, when the tree had been set six years, and one year after the blasting. It has since developed quite rapidly and is now more than three times as large as the trees not blasted.

Last year the trees where blasted withstood the drought and matured much larger crops and better filled nuts than did the trees not blasted.

I just drive a crowbar three feet into the ground on three sides of the trees, in a triangular shape, about the ends of the roots and blast them with one-half a cartridge charge any time in the fall or early spring when the ground is dry. In land where I grow crops the blasts are placed on only two sides. If this is done in the fall so that the broken soil can take in the winter rains, you need not be uneasy about dry summers and shedding nuts. I have advised blasting for years for setting out trees, and now I am convinced it pays in cultivating them.

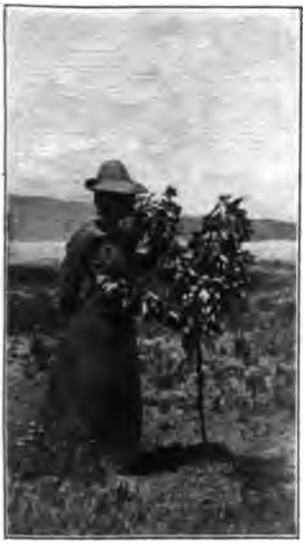
Where the subsoil is very poor a little manure placed in the blasted holes gives good results.

J. A. KERNODLE,
Camp Hill, Ala.

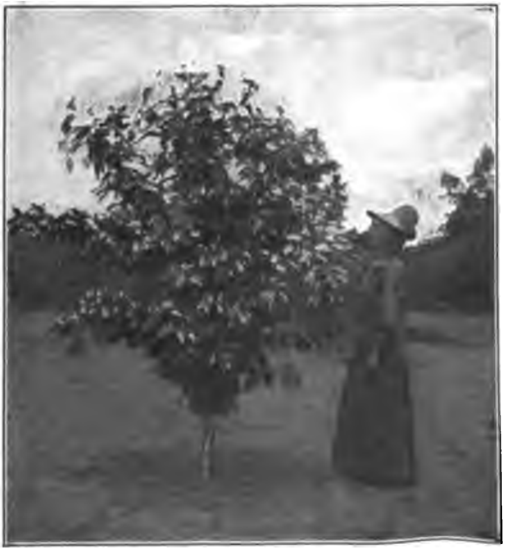
Blasting Pays Almost Anywhere

After having read the remarkable symposium of expert testimony in the preceding pages, there will still be doubting Thomases who will say: "Blasting might be a good thing in some States, but not in this State." While it is true there are some States where blasting is not as advantageous as in others, such as in Michigan, with its loose, sandy soils, and Iowa, with its deep prairie loams, we direct special attention to the Hale Georgia Orchard Co., letter covering their experience in sandy soil, and to the fact that the New Jersey Horticultural Department found blasting beneficial at the Vineland, N. J., Experiment Station, where the soil is sandy loam. It must be borne in mind that loose soils acquire plow soles, and also become diseased. Blasting breaks plow soles and kills by shock many inimical organisms in old orchard soils.

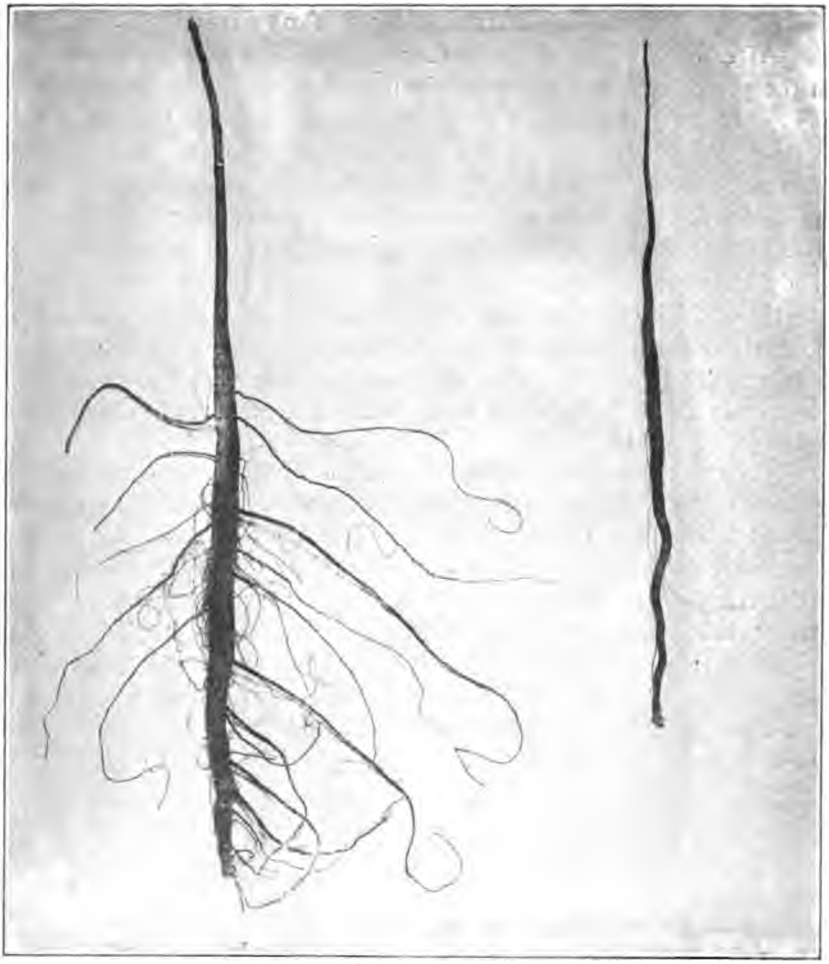
To prove the almost universal adaptability of blasting, we publish herewith brief extracts from letters in our files from all over the United States. No matter where you live there is some one within reasonable distance who knows from experience the benefits of blasting orchard soil. Therefore, if this booklet fails to convince you, we urge you to ask someone in your vicinity whose name and postoffice is printed herein. Don't plant any more trees until you settle this important question to your satisfaction. Out of every hundred who investigate blasting, we are confident ninety will adopt it. You cannot afford not to investigate!



BING CHERRY TREE, TWO YEARS OLD, SET IN SPADED HOLE IN 5-FT. OREGON LOAM



BING CHERRY TREE, TWO YEARS OLD, SET IN DYNAMITED HOLE (See Mrs. Rawley's letter on page 91.)



THE STOVER ROOTS. FROM BLASTED AND UNBLASTED SOIL

BAY MINETTE, ALA., January 29, 1913.

Du Pont Powder Co., Wilmington, Del.:

GENTLEMEN:—Answering your inquiry regarding the planting of the seedlings I exhibited at the meeting of the Alabama Horticultural Society, and which you later sent to your office at Wilmington to be photographed, wish to say:

Both seedlings were planted about April 1, 1912, and were taken out of the ground after they were growing for ten months. Both seeds were of the same variety, running about 130 seeds to the pound. The specimens which I presented were of an average of seedlings planted with and without Red Cross; the average diameter for the blasted seedling being 1 inch, and for the unblasted, ½ inch. The kind of soil in which these seedlings grew was a stiff Norfolk clay. The cultivation, fertilization and care which these received were similar.

As for growth, the blasted seedling is a full year ahead of the unblasted one, and, in all respects, is a much better specimen. My idea of planting seedlings in blasted holes was a matter of experiment with me, and am glad to say that it has proved very profitable.

Very truly yours,

J. M. STOVER.

Underground Effects Upon Roots of Trees Planted With Red Cross

Although Red Cross has been used for blasting holes in which to plant fruit trees as long ago as twenty years, it has only been within the last three years that the practice of blasting holes has become at all general. The method is now known and used in every State in the Union. It is enthusiastically recommended by horticulturists, nurserymen and fruit growers, who have tried it and who have carefully noted results.

Many photographs, showing comparative surface growth and development of trees planted in blasted and spade-dug holes, have been published, but it was only very recently that any photographs could be shown of root development. It is an accepted fact horticulturally that a tree's root system is practically commensurate with its above-ground limb and branch system. It is, therefore, of interest from a scientific standpoint to actually see the growth made by roots which have been assisted to penetrate the feeding bed by blasting the subsoil with Red Cross in comparison with the growth made by a young tree of the same age, in the same type of soil, planted in an adjoining plot in a spade-dug hole.

Figures 1, 2, 3 and 4, shown on page 78, provide such views. Figures 1 and 3, are views of trees planted in blasted holes; figures 2 and 4, of trees planted in spade-dug holes. It will be interesting to note the superior root development of the trees shown in figures 1 and 3. It will also be seen that the branch development of these trees is in proportion to the root growth.

The trees shown in figures 2 and 4, have much smaller root development and, as is to be expected, similarly small above-ground growth.

The reader's attention is specially called to the uniform growth or spread in every direction of the roots shown in figures 1 and 3. The soil, having been thoroughly pulverized and mellowed by the blasting, has enabled the roots of these trees to penetrate their feeding beds easily and evenly in all directions, thus not only securely anchoring the trees and protecting them against damage by high winds, but enabling them to reach plant foods in every direction from their trunks.

Observe the difference in figure 2. Here the roots are shown bunched and extending in one direction only. How much less securely anchored and how much more at the mercy of the winds is a tree with such root development; also how much more restricted is its feeding ground, the plant food in the soil on the sides of the tree not penetrated by its roots all practically going to waste.

The chief objection to starting an orchard is the slow return from the investment. Experience has proved that trees set in blasted ground bear fruit one to two years earlier; the loss from dying trees is practically eliminated, and the benefits of such planting are continuous.

Figure the cost of the trees for an acre of orchard, plus cost of spade planting, plus taxes for the fruitless years, plus 33 per cent. average first year loss of trees, and another year's delay to replace them, plus interest on value of land during the fruitless years. Then figure again using the planting-with-explosives-costs, eliminating the first year losses, and cutting down fruitless years by at least one.

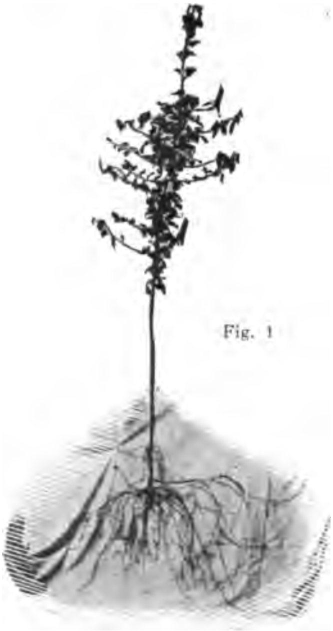


Fig. 1

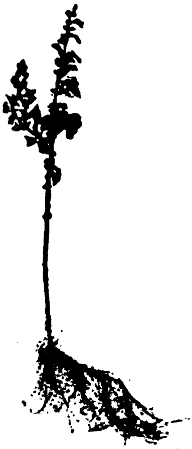


Fig. 2

Even if the fruit from trees planted in blasted ground were not superior in size, color and flavor, the financial advantage apparent from the above calculation should cause every orchardist to adopt the blasting method, except those having a deep soil, mellow to a depth of five to six feet, in which case blasting will be of no benefit, except to destroy fungus, nematode, etc.

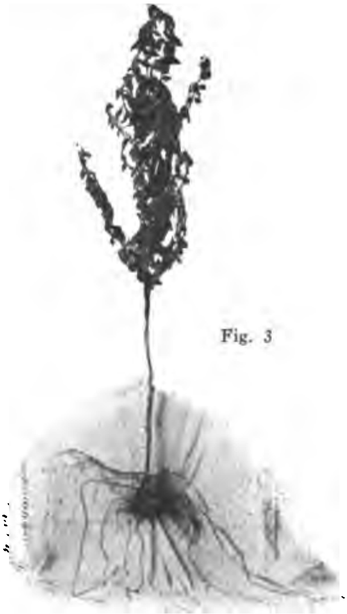


Fig. 3

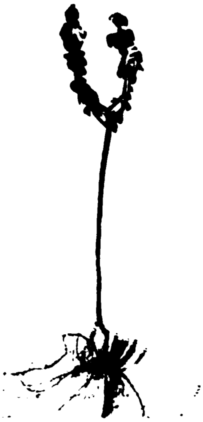


Fig. 4

OVERWHELMING NATIONAL EVIDENCE

ALABAMA

BLASTED TREES GREW TWICE AS FAST

CULLMAN. Planted orchard with Red Cross. In spite of dry weather, trees attained twice the growth over those in spade-dug holes.

ED. B. MILLER, Supt.,
Alabama Odd Fellows Home.

LOSS LESS THAN TWO PER CENT.

GREENVILLE. Planted 170 trees in blasted holes. Only two died. Trees in blasted holes are twice as far advanced as those in spade-dug holes.

A. H. VANN,
Oak Lawn Farm.

BLASTED TREES LIVED; SPADE-PLANTED DIED

DOTHAN. Planted 10 Satsuma Orange trees with Red Cross and 10 without. Lost two planted in blasted holes and only had two to live in spade-dug holes. Intend to plant all trees in the future with Red Cross.

E. R. PORTER CO.

BENEFITS FAR IN EXCESS OF COST

CITRONELLE. Planted 1,000 trees with Red Cross. Consider benefits far in excess of the cost and recommend its use to all who contemplate planting trees of any variety.

R. L. SCOTT, Sec'y and Treas.,
Citronelle Nursery & Orchard Co.

HAD TO TRIM FAST GROWTH

FAIRHOPE. Trees set in blasted holes have grown so fast and large, they are top heavy. Had to trim branches.

C. L. COLEMAN.

REMARKABLE RESULTS

EVERGREEN. Used Red Cross in planting trees at Baptist Orphans' Home. Results were so remarkable they ordered more trees planted in the same way.

T. H. BRASWELL.

ARKANSAS

EARLIER AND BETTER YIELD

FAYETTEVILLE. Planted 1,100 peach trees with Red Cross. They made better growth than any trees in neighboring fields, bore earlier and fruit had better flavor.

I. W. BAXTER,
Sam A. Clark & Co.

CALIFORNIA

GOOD RESULTS WITH ORANGES

FAIR OAKS. Planted 300 orange trees with Red Cross. Results very favorable. Expect to plant 30 acres more in the same way.

PERCY S. MEANEY.

FINDS IT ECONOMICAL

SACRAMENTO. Planted 200 acres of trees in blasted holes. Am convinced that the cost and percentage of loss can be materially reduced by the use of Red Cross.

E. P. HILBORN,
Mission Olive Orchard Co.

ROCKY SUBSOIL CONQUERED

PENRYN. Planted trees with Red Cross where hard bed rock is very close to the top soil and found them to grow better than trees planted in spade-dug holes.

H. A. SNELLING,
Penryn Fruit Co.

HARDPAN EASILY SHATTERED

RIVERSIDE. Satisfied after the first work with Red Cross. Whatever the cost, it is money well spent. Hardpan is easily shattered by this method. Do not hesitate to use Red Cross, for you can find nothing better.

JAMES MILLER, Supt.
Arlington Heights Fruit Co.

GAINED MORE THAN A YEAR

TUDOR. Planted 100 trees in blasted holes. They grew larger and faster than trees planted the year before in spade-dug holes. Red Cross beats anything I ever saw for making trees grow fast.

JAMES GRUBB.

ADOPTED AFTER EXPERIMENT

AZUSA. Planted 400 trees with Red Cross, after seeing good results obtained by a neighbor on three trees planted in blasted holes. Will plant more trees in the same way.

THOS. A. SMITH.

MADE $15 LAND WORTH $200

DAVIS CREEK. Planted 14,000 fruit trees with Red Cross, and by its use have advanced the value of land from $15.00 per acre to $200.00 per acre in less than a year.

O. C. LANGFIELD.

REJUVENATED SICKLY TREES

SARATOGA. Planted a block of five trees, in spade-dug holes, that did not grow. Afterwards used Red Cross to rejuvenate them and the trees showed vigorous growth at the end of the first year.

GUY U. SMITH,
State Assemblyman.

THE TREES ARE THE BEST PROOFS

FLORIN. Planted row of trees in blasted holes. They speak for themselves and are a monument for all time.

JAMES RUTTER.

A DECIDED SUCCESS WITH ORANGES

RIVERSIDE. The use of Red Cross in our orange orchard has been a decided success.

GEO. ROUNTHWAITE.

DO YOU PREFER SCRUBS?

CARPENTERIA. Used Red Cross in planting 1,000 trees. Trees planted in spade-dug holes look like scrubs beside the ones planted in blasted holes.

CHAS. L. LUNDY.

EXPERIMENT YIELDS PROOF

ORANGE. Used Red Cross in the center of some squares in my orange grove. The experiment confirmed my belief of long standing that many of our groves planted on the heavier soils would be much benefited by the intelligent use of Red Cross.

C. J. K. JONES.

BEATS ANYTHING HE EVER SAW

PLACERVILLE. Blasted 19 tree holes with two sticks of Red Cross in each hole. Beats anything I have ever seen for digging out holes. Will plant no more trees in spade-dug holes.

RAY PHELPS.

MORE THAN REPAYS COST

FUSTIN. Planted 400 orange trees with Red Cross, which later proved to more than repay the extra cost in planting.

PERRY LEWIS.

WATER STORAGE CAPACITY INCREASED

AUBURN. Planted trees with explosives with decided success. Blasting increases water storage capacity of the soil and trees will have more vigor and vitality, will grow faster, bear earlier and be more productive and longer lived.

J. A. TEAGARDEN.

PULVERIZES HARDPAN

CORONA. Lemon trees on strip of orchard blasted last fall show a marked improvement in appearance. Intend treating all portions of orchard where conditions of trees indicate existence of a hard formation under them.

W. C. McCULLY, Mgr.,
El Cerrito Rancho.

SAVES IRRIGATION

RIVERSIDE. Found blasting saves one to two irrigations per year.

RIVERSIDE CHAMBER OF COMMERCE.

AN INTERESTING TEST

MARYSVILLE. Planted one tree in blasted hole and two acres of trees in spade-dug holes. The tree in blasted hole made very good progress, while one-half of the other trees died. Was prompted to plant two more acres with Red Cross.

MR. E. E. LONG.

YIELDS TREBLED BY BLASTING

SANTA ANA. Took 21 boxes of fruit from orange trees set in blasted hole and only seven from tree in spade-dug hole. Find Red Cross to be a great labor saver.

E. C. FRAZEN.

ONLY SUCCESSFUL METHOD

SAN DIEGO. Planted 20 acres of lemons with Red Cross. Find it to be the only successful method for planting trees.

W. R. GUNNIS,
Pacific Wood & Coal Co.

PULVERIZES HARDPAN

STRATHMORE. Planted trees with Red Cross and feel confident that it was a great benefit, pulverizing the hardpan, and allowing the roots to penetrate same.

THE STRATHMORE CITRUS NURSERIES,
H. C. VAN DE WATER, Mgr.

PLUMS GAIN A YEAR

DINUBA. Planted 600 plum trees in blasted holes. Have one year's growth over trees in spade-dug holes. Would not blast without the use of Red Cross.

OMEGA RANCH,
Z. M. DICKEY, Mgr.

MARKED ADVANTAGE FROM BLASTING

WOODLAKE. Planted 600 acres of lemon and orange trees with Red Cross. Find a marked difference between the trees in blasted holes and the ones in spade-dug holes.

G. F. STEVENSON,
Woodlake Orchard Co.

COLORADO

NURSERY HIGHLY RECOMMENDS BLASTING

LOVELAND. Used 2,000 lbs. Red Cross in planting 10,000 trees. Results very satisfactory. We highly recommend its use in orchard planting.

THE NORTHERN COLORADO NURSERY CO.,
M. R. KILBURN, Mgr.

FRUIT WON WORLD'S PRIZE

GOODPASTURE. Planted 300 trees with Red Cross at only one-tenth of the cost of setting the same amount of trees in spade-dug holes. Fruit from trees in blasted holes won World's Prize.

LEE R. ROPER.

GAINS A YEAR'S GROWTH

OXFORD. Trees planted with Red Cross have done finely. Had but little loss and trees are thriftier. Trees in blasted holes have one year's growth over those planted in spade-dug holes.

L. A. O'DONNELL.

INDUCES PHENOMENAL GROWTH

DENVER. Planted trees in cherry orchard with Red Cross. Growth of trees phenomenal. The loss about two per cent., due to poor stock. Trees were overheated in transportation.

J. B. GEIJSBEEK.

STOPS FIRST YEAR LOSS

DENVER. Lost only nine trees out of 728 planted with Red Cross and am convinced an additional advantage is obtained by its use. Would not consider planting any other way.

F. W. GRAHAM.

INCREASED YIELD 60 PER CENT.

GRAND JUNCTION. I had 14 pear trees in my orchard that never produced over 71 boxes or five boxes to the tree. Since using Red Cross in this orchard, the trees have regularly produced 114 boxes or eight boxes to the tree.

CHAS. P. SHEEHAN.

BLASTED TREES 50 PER CENT. BETTER

RIFLE. Trees planted in blasted holes are 50 per cent. better than those in spade-dug holes.

J. L. STEWART.

GREATLY REDUCED FIRST YEAR LOSSES

DENVER. Planted 70,000 fruit trees with Red Cross. Loss less than five per cent. In previous years the loss has been about 30 per cent. Growth of trees in blasted holes wonderful.

DENVER SUBURBAN HOME & WATER CO.,
H. R. CRANE.

CONNECTICUT

REJUVENATES SIXTY-YEAR-OLD ORCHARD

STONINGTON. Used Red Cross to improve sixty-year-old apple orchard which had borne nothing for several years. Have been much gratified at the results. Entire orchard loaded with apples and fruit much larger than usual.

EUGENE P. EDWARDS.

BLASTED TREES THRIVE ON POOR LAND

MANCHESTER. Planted fruit trees on rocky hillside, using Red Cross to dig the holes. Trees are growing and coming on good.

C. R. BURR & CO.

CHEAPER AND BETTER THAN SPADE PLANTING

NORWICH. For the past three years, have used explosives with great success in planting my young trees. It not only does the work better but cheaper than digging holes by hand.

THE KITEMAUG ORCHARD CO.,
F. W. BROWNING, President.

RECOMMENDS BLASTING FOR REJUVENATION

GLASTONBURY. On account of successful results from blasting Hale Georgia Orchard Co., peach orchards in Georgia recommends blasting old New England apple orchards to rejuvenate them.

J. H. HALE.

DELAWARE

REGRETS ALL TREES WERE NOT BLASTED

COOCH'S BRIDGE. My experimental plots of trees in blasted ground showed such increased growth over those planted with spade, I regret all were not blasted.

L. H. COOCH,
Farm Adviser, Delaware Experiment Station.

DISTRICT OF COLUMBIA

EX-SECRETARY MOORE EXPECTS TO GAIN TWO YEARS

WASHINGTON. Planted 35 acres of trees with Red Cross and am of the opinion they will make five years' growth in three years.

WILLIS L. MOORE,
Ex-Sec'y U. S. Dept. of Agriculture.

FLORIDA

QUICK RESULTS FROM REJUVENATION

FT. MYERS. Blasted my grape fruit grove of 350 trees about a month ago. Trees are putting on a beautiful new growth. I consider it worth $1,000 more than before I used explosives.

H. O. BANISTER.

ENSURES THRIFTY TREES

HOLDER. Planted citrus grove in blasted holes during February, 1913. Result, fine crowns, very thrifty trees.

HENRY G. BYSTRA.

EXCELLENT RESULTS IN FLAGLER GROVE

MIAMI. Red Cross proved extremely satisfactory and most inexpensive in rejuvenating 8,000 grape fruit trees in the Kendal Grove owned by Mr. H. M. Flagler. This (1911) is the first year the Kendal Grove has borne any crop of consequence, the yield amounting to 4,300 boxes, which is excellent considering the age of the grove.

J. E. INGRAHAM, Supervisor Kendal Grove,
Vice-Pres. Florida East Coast Railway.

GEORGIA

GAINS TWO YEARS WITH PECANS

COLUMBUS. Used Red Cross in planting pecan trees. Trees in blasted holes are about three times as large as those in spade-dug holes and came into bearing two years earlier.

F. W. McMURRAIN.

100 vs. 58

AUGUSTA. Sold a customer sufficient explosives to plant 100 trees. At the same time, his neighbor planted 100 trees using the old way of digging. Neighbor has 58 trees living while our customer did not lose a single tree.

LAMB & HOLLINGSWORTH.

BLASTED TREES GROW ONE-THIRD BETTER

FORT VALLEY. Trees planted in blasted section of orchard have a growth of 33⅓ per cent. more than the unblasted section. Leaves have a much better color and trees are standing dry weather better than the unblasted trees.

DUKE BROTHERS.

THE FINEST HE EVER SAW

FRANKLIN. Trees I planted two years ago with Red Cross are the finest trees I ever saw. My business is selling fruit trees. If you will send me a supply of your booklets, I will hand them out to all of my customers. I would like to see them all plant their trees in blasted holes.

GEORGE ALEXANDER.

SPLENDID RESULTS WITH PECANS

MILLEDGEVILLE. Planted 1,500 pecan trees with Red Cross. Obtained splendid results. Trees have shown vigorous growth and bore nuts sooner than they otherwise would have done.

EDWARD & PATTERSON.

GAINED TWO YEARS

MAYFIELD. Planted peach trees with Red Cross. These trees will bear as much fruit at four years old as they would at six without the use of explosives.

W. W. STEVENS.

FIRST YEAR LOSS ALMOST NOTHING

CHAMBLEE. Out of 3,000 trees planted with Red Cross only two have died. Trees in blasted holes are very much larger than those in unblasted holes.

A. E. COLE.

WHY BLASTING REJUVENATES

BACONTON. Will recommend Red Cross highly for use under old trees as it leaves the ground in a soft and porous condition, enabling the roots to take advantage of the moisture and available plant foods.

BARNWELL PECAN ORCHARDS CO.

FINE FOR PECANS

DE WITT. Mr. Bacon told a Du Pont salesman that blasting had been employed experimentally in tree planting in 1912 on the pecan properties owned by his company; that the trees in the blasted holes did much better than other trees on the same plot; that in future planting work, they intended using explosives.

G. M. BACON PECAN CO., INC.

IDAHO

GROWTH OF TREES MARVELOUS

BOISE. In the fall of 1912, used Du Pont explosives to break up hardpan and subsoil in my orchard. Trees were planted the following spring and given the usual cultivation. Gave the orchard a light irrigation the first of July and did not irrigate again that season. Growth of trees marvelous.

T. A. JOHNSON.

ILLINOIS

MORE THAN PLEASED

NAPERVILLE. Planted 350 trees in blasted holes. We are more than pleased with the results obtained and thoroughly recommend the use of Red Cross.

F. W. VON OVEN, Mgr.,
The Naperville Nurseries.

INDIANA

GROW RIGHT THROUGH DROUGHT

NEW ALBANY. Planted 4,000 trees with Red Cross. Loss of trees will not exceed 5 per cent., although we have had a six weeks' drought.

NEWTON A. GREENE,
Mayor.

CHEAPER TO BLAST THAN DIG

COLUMBIA CITY. Planted 200 fruit trees with Red Cross. At the same time, planted 18 trees in spade-dug holes and they cost me twice as much per tree as planting with explosives.

ARTHUR E. HANCOCK.

KANSAS

BLASTED TREES BEAR FRUIT EARLY

COLUMBUS. Planted three peach trees in blasted holes and six in spade-dug holes in the same ground. Three years later, trees in blasted holes were stronger and healthier and produced from five to six bushels of very fine peaches. Trees planted in unblasted holes bore practically no peaches, both fruit and leaves having shriveled up and dropped off during dry season.

W. R. MACDONALD.

KENTUCKY

GAINED A YEAR WITH APPLES

MILBURN. Planted 100 apple trees with Red Cross. They produced fruit one year earlier than those in spade-dug holes.

D. P. SANFORD.

LOUISIANA

100 PER CENT. vs. 20 PER CENT.

COVINGTON. Planted a number of trees with spade and not 20 per cent. grew. Planted in blasted holes and every one of them grew. Would not think of planting trees without Red Cross.

G. C. ALEXIUS.

STOPS FIRST YEAR LOSS

SHREVEPORT. Used Red Cross for planting 1,080 pecan trees. Planted 8,000 peach trees without. The percentage lost on the pecan trees was almost nothing compared to the loss of peach trees during the dry spell.

S. H. BOLINGER,
Clear Creek Lbr. Co.

MAINE

BEYOND COMPARISON

AUBURN. Have not seen or heard of trees to come up to our young orchards that were planted with Red Cross.

HOMER N. CHASE & CO.

MARYLAND

EASY TO PLANT IN BLASTED GROUND

BALTIMORE. Planted 40 fruit trees with Red Cross and was very much pleased with the easy way of working it.

CHAS. FEHRMANN & CO.

FRUIT TWICE AS GOOD

SNOW HILL. Planted pear and plum trees with Red Cross. Trees in blasted holes brought $2 per bushel. Fruit from trees in spade-dug holes only brought $1 to $1.25 per bushel.

T. J. SELDER.

MASSACHUSETTS

MARSHFIELD. Planted 80 apple and cherry trees in blasted holes and 20 in spade-dug holes. Only three of the trees planted in blasted holes died; whereas, 12 of those planted in dug holes died. Had never used Red Cross before doing this work, but had no trouble in following the instructions.

CHAS. P. DUFFIE, Jr.

OTHER METHODS ARE OBSOLETE

SPRINGFIELD. In spite of a drought which set in immediately after I had planted 264 trees with Red Cross, every tree lived. Planting trees without Red Cross is obsolete, wasteful of time and money. I cannot afford to plant without it.

V. J. IRWIN, M. D.

MADE SPLENDID GROWTH

BOSTON. Planted 1,500 trees with Red Cross. They made splendid growth. Will plant more in the same way.

FRANK I. COOPER.

GETS APPLES IN ONE YEAR

BOSTON. Planted 15 trees with Red Cross. One tree out of the 15, not more than one-half or three-quarters of an inch in diameter, had two large perfect apples at the end of the first year. Consider this to be a most remarkable circumstance.

F. S. HILL.

MICHIGAN

SOUTH HAVEN. Used Red Cross to pulverize soil between trees in orchard, with splendid success.

CHAS. E. ABELL.

GRAND LEDGE. Blaster Duzenberry reports his best advertisement is an orchard of 1,200 trees set in blasted ground for Mr. Gordinere, everyone of which lived and developed nicely.

MINNESOTA

CHEAPER AND QUICKER

VIRGINIA. In future the Park Board of Virginia will use Red Cross for tree planting, as the work can be done cheaper by this method and also quicker, especially when labor is scarce.

ARTHUR A. BEISCHJOLD,
Supt. of Parks.

ANOTHER CONVERT

LAWLER. I considered it all a fake to plant trees with explosives until it was proved to me last fall that it not only paid well, but no one can afford to use the shovel for digging fruit tree holes.

V. CARLSON, Proprietor,
Lakeview Nursery.

MISSISSIPPI

FINE FOR PECANS

OCEAN SPRINGS. Cannot conceive of any other method that will put the ground in as satisfactory condition for root-system.

OCEAN SPRINGS PECAN NURSERY.

MISSOURI

BY FAR BETTER

BRANDSVILLE. Planted 240 acres of trees with Red Cross. They are by far better than any raised in spade-dug holes.

J. F. SHOEMAKER.

REDUCES LABOR ITEM TO MINIMUM

MELVA. Have used Red Cross in planting fruit trees with good results. The labor item was reduced to a minimum. Shots shattered hardpan and left soil mellow and friable.

HERBERT T. WILTSE, Mgr.,
The Ridgedale Orchards Co., Inc.

METHOD CAN'T BE BEAT

WEBB CITY. Although last spring and summer were the worst in years, not one of the trees planted in blasted holes died. For inexpensiveness and satisfactory results, the explosives method can't be beat.

W. R. ROBERTSON,
Lawyer.

MAKES TREES GROW IN TOUGH SOIL

JOPLIN. Set out 823 trees in McClelland Park and on the Boulevard by shooting the holes with Red Cross. Soil was flint and hard clay. All lived except 14. We attribute this remarkable record to the use of explosives.

M. F. KEITH,
Supt. of Parks.

SAVED 60 PER CENT. IN DROUGHT

APPLETON CITY. Set out 700 trees with Red Cross last spring and then had the worst drought in 10 years. Was surprised to find that 60 per cent. of our trees thrived; without explosives all would have died.

BURT CLINE.

REJUVENATION SUCCEEDS

WEBB CITY. Planted one acre to peach trees in 1907 without explosives. Lost all but 50 trees. Growth of those living did not exceed 15 inches. In 1910, used Red Cross to rejuvenate remaining trees. In spite of unfavorable weather, I lost no trees and growth was from 18 to 40 inches in one season.

M. S. WILLIAMS.

FULLY CONVINCED

KANSAS CITY. I am an earnest apostle of the use of Red Cross in tree planting.

S. G. WARNER, G. P. A.,
Kansas City Southern Railway Co.

TWICE AS BIG IN SIX YEARS

ST. JAMES. Norwegian maple planted at roadside in six years grew sixteen feet against eight feet of spade-set tree.

J. F. BURGE.

MONTANA

MADE MUCH BETTER GROWTH

DARBY. Planted 40,000 trees in blasted holes. Trees made a much greater growth than those planted one year before where Red Cross was not used.

W. I. MOODY,
Como Orchard-Land Co.

A GREAT TIME AND LABOR SAVER

HAMILTON. Planted 36,000 apple and cherry trees with Red Cross and found it to be a great time and labor saver.

WALTER E. LONG.

NEBRASKA

GOOD FOR LARGE TREES

BENSON. I find that Red Cross is a good help even in planting large trees.

R. TIMMLER,
Landscape Gardener and Nurseryman.

MORE, BETTER AND QUICKER FRUIT

ALLIANCE. Trees planted with Red Cross have made a wonderful showing and my customers are getting full returns in the way of more fruit, better fruit and quicker fruit. Holes cannot be dug in the hard soil in this district with a spade for twice the cost of explosives.

J. P. BARGER, Prop.,
Alliance Nursery.

NEW JERSEY

FINDS BLASTING OF VALUE IN GRAVELLY LOAM

VINELAND. New Jersey Horticultural Society Proceedings for 1912 reports that peaches set in loose gravelly loam at the Vineland Experiment Station showed considerable gain in growth over trees set by ordinary method.

ALL OF 1200 LIVED

MIDDLEBUSH. Of my 1,200 trees set with Red Cross all lived and are fine specimens. Of 50 trees planted by a neighbor with spade in next lot 49 trees died.

NEW MEXICO

A COLLEGE ENDORSEMENT

STATE COLLEGE. From Press Bulletin No. 243 N. M. College of Agriculture and Mechanic Arts: "In heavy adobe soils it has been found advantageous to explode small charges of Red Cross, 18 to 36 inches beneath the surface to form a hole for the tree, at the same time loosening the soil to a greater extent, both in surface area and depth, than is possible when holes are spaded."

ROLAND HARWELL,
Assistant in Agronomy.

NEW YORK

GETS PLEASING RESULTS

ROCHESTER. Formerly a partner in the Hooker Wyman & Company Nursery. Now a nursery broker. Own a 10-acre orchard which was planted in blasted holes. Am well pleased with its progress.

W. W. WYMAN.

EDITOR ENDORSES METHOD

ROCHESTER. Believe in and advocate use of explosives for planting trees.

ELMER E. REYNOLDS,
Editor of *Rural Life*.

WHY BLASTED TREES THRIVE

MIDDLE GRANVILLE. Planted 500 trees in blasted holes. Will never again entertain the thought of setting trees in the old way. Trees set in blasted holes have by far the advantage over trees set the old way, as the subsoil is so shattered that the roots find it easy to shoot out and find the necessary plant food.

HICKS BROS.

FAST WORK

TOWNES. Planted 7,200 trees in blasted holes in 1,440 hours. Average number planted per day was 720. This would have been impossible without the assistance of Red Cross.

C. W. KIMBALL.

A TIP FOR NURSERYMEN

ONEONTA. Used explosives in preparing seed beds. The following year, seedlings were taken out to see whether they were stronger or healthier than other trees planted at the same time on unblasted land. Tap roots of young seedling trees on blasted ground fully 15 inches longer than those on unblasted plots.

MR. JUNE, Supt. of Nurseries,
Delaware & Hudson R. R.

A GREAT SUCCESS

BINGHAMTON. Planted 150 trees with Red Cross and same was a great success.

L. J. ENGLISH.

GAINED ONE-THIRD IN A YEAR AND A HALF

YOUNGSTOWN. Trees planted in blasted holes made 1/3 better growth, in a year and a half than those planted in spade-dug holes.

HENRY LUTTS.

MAKES STURDIER TREES

HOLLEY. Planted 50 fruit trees in blasted holes. They are much better matured and sturdier than those in spade-dug holes.

SETH A. ALLIS & SON.

MADE WONDERFUL HEADWAY

NEW YORK CITY. Apple trees planted with Red Cross have made wonderful headway.

W. S. MYGRANT.

GAINED A YEAR'S GROWTH

MILTON. Four hundred trees planted in blasted holes have made a year's growth over those in spade-dug holes.

J. R. CLARKE & SON.

ENTIRELY SATISFACTORY

OAKFIELD. Mr. J. W. Drake, of Elba, N. Y., has finished a job of tree-planting with Red Cross to my entire satisfaction.

C. D. ROBERTS.

NORTH CAROLINA

NEVER AGAIN WITHOUT BLASTING

TYRON. Used Red Cross to set out 4,600 grapevines, two acres of apple trees and two acres of peach trees. Vines and trees have done remarkably well. Will never plant vines or fruit trees in any other way.

BELLA VISTA FRUIT & POULTRY FARM,
B. C. von Kahlden, Prop.

TREES GREW FINE

REDDIES RIVER. Planted 6,000 trees with Red Cross and they grew fine. Blasting is the only method of digging holes for trees, as it breaks the earth all around them.

W. J. PALMER.

DID VERY EFFECTIVE WORK

NORTH WILKESBORO. The Red Cross I used to plant 500 peach and apple trees did very effective work and gave them a permanent growth that could not be gotten any other way.

H. W. HORTON, Sec'y and Treas.,
Citizens' Loan & Trust Co.

SURPRISING GROWTH

OAKWOODS. Planted 1,000 apple and peach trees with Red Cross in 1913. Growth of young trees surprising.

GOLD MEDAL ORCHARDS.

CONVINCED

DAVIDSON. Am so convinced of the value of planting trees with Red Cross that I have planted 1,500 in this way, and expect to plant all the rest with Red Cross.

HENRY LOUIS SMITH,
Brushy Mountain Orchards Co.

WITHSTAND DROUGHT

CHARLOTTE. Fruit trees planted on my farm with Red Cross are withstanding the drought much better than those planted otherwise.

JAS. O. GARDNER.

LIKE THE METHODS

WAYNESVILLE. Set apple trees in blasted holes. Like the method very much.

R. N. BARBER.

OHIO

SOLVES REPLACEMENT PROBLEM

GYPSUM. Used explosives to remove dead trees and to replant new trees in place of them. Opening up and aerating the soil and the destruction of insect life by blasting solved the difficult problem of making a young tree grow where an old one had been removed.

WM. MILLER & SON,
Elmwood Fruit Farm.

SAVES DYING TREES

ELYRIA. Many an old tree along sidewalks have I saved by exploding small charges below the root system, tamping them in with fertilizer.

M. J. WALTERS.

REDUCES COST

YOUNGSTOWN. After planting trees in City Park with Red Cross, am convinced it is the only way to plant trees and shrubs. It reduces the cost materially and promotes better growth.

LIONEL EVANS, Supt. of Parks,
Board of Park Commissioners.

GAINED TWO YEARS

CLEVELAND. Saved fully 15 per cent. by planting 7,000 trees with Red Cross. They made a better showing than trees planted two years before in the same soil with spade.

GEO. H. BURROWS,
The Geo. H. Burrows Dev. Co.

SPLENDID RESULTS

ST. CLAIRSVILLE. Used Red Cross in planting orchard trees. Had such splendid results, expect to plant from 500 to 1,000 more in the same way.

J. W. RILEY,
The Riley Fruit Farm.

WOULD NOT CONSIDER ANY OTHER WAY

MACEDONIA. Planted 4,000 trees in blasted holes, and have as fine orchard as could be desired. Would not consider planting trees any other way.

ROY S. OSBORN.

MORE VIGOROUS GROWTH

CLEVELAND. Planted 3,000 trees with Red Cross. They have made quicker and more vigorous growth than trees in spade-dug holes.

J. M. HILBISH, Mgr.,
The Lake Erie Apple Orchards.

THE ONLY WAY

TACOMA. Planted 25 trees with Red Cross and 15 in spade-dug holes. Lost one in blasted holes and just two lived in spade-dug holes. Fully convinced that the only way to plant trees is with Red Cross.

T. W. BRANSON, Supt.,
Belmont County Children's Home.

ALL FLOURISH

JEFFERSON. Planted about 50 trees with Red Cross. All in flourishing condition.

CHAS. R. SARGENT, Sec'y,
The Ashtabula Co. Agricultural Society.

RESULTS FAVORABLE

PIQUA. Planted 200 fruit trees with Red Cross. Results very favorable.

A. J. SCHNEYER.

RESULTS BEYOND EXPECTATIONS

NELSONVILLE. Planted 800 trees with Red Cross. Results were beyond my expectations. Am convinced that it is the only way to prepare soil for planting trees, and expect to plant 5,000 more apple trees in the same way.

C. S. TEDROW, Land Agent,
New York Coal Co.

MADE WONDERFUL GROWTH

WARRENVILLE. Planted 10 acres of apple orchard with Red Cross and 10 acres without. The trees set in blasted holes made wonderful growth with less than 2 per cent. lost. Trees set without Red Cross had at least 15 per cent. dead trees.

G. J. WILDER, Mgr.,
B. of Sci. Agric., Cooley Farms.

THOROUGH AND SURE

NEWARK. The only way to plant trees is with Red Cross. It is thorough, quick, economical and sure.

JOHN P. CAMP.

OKLAHOMA

SUPERIOR FRUIT

BLACKWELL. Used Red Cross in planting 2,500 trees. Fruit is much superior to those in spade-dug holes.

J. W. TETIRICK.

GROWTH DOUBLED

LONE GROVE. Trees planted in blasted holes, at the end of the first season were nearly twice as large as those planted in spade-dug holes.

C. C. RITTENHOUSE.

OREGON

COST HALF AS MUCH

PORTLAND. Trees planted in blasted holes show marked improvement over those planted by spade. Blasted holes cost just one-half as much as spade-dug holes.

IRVING WORTHINGTON, C. E.,
Rogue River Valley Canal Co.

MONEY WELL SPENT

GRANTS PASS. Planted 3,000 trees in blasted holes. Found that Red Cross is money well spent in orchard planting on any kind of land.

TOKAY HEIGHTS DEVELOPMENT CO.

MORE AND BETTER FRUIT

MEDFORD. Orchard rejuvenated by blasting between trees yields more and better fruit.

J. H. NEUSTADT,
Owner Liberty Orchards.

BLASTS EVERY TREE HOLE

GRANTS PASS. Thirty acres of new orchard and every tree set with Red Cross. Would not undertake to clear ground or set new trees, shade or orchard, without using it.

MRS. JOHN RAWLEY.

PENNSYLVANIA

CAN'T BE BEAT

POTTSTOWN. Have used explosives for 15 years on my two farms. For planting trees, Red Cross can't be beat. Blasted trees are finest in the orchard. Would not plant a tree without explosives and heartily recommend their use as a labor saver.

J. C. SAYLOR,
Cedar Grove Fruit Farm.

INCREASED YIELDS

GLENBURN. Used Red Cross to rejuvenate my apple orchard. Yields materially larger. Got 211 bushels the first year and 537 bushels the second year from 56 trees—all strictly first grade, hand-picked apples.

C. E. McCORMICK, Mgr.,
Red Top Farm.

97 PER CENT. SUCCEED

BALLY. Planted 700 apple and 100 peach trees, using Red Cross to dig the holes. Am very well pleased with results. Although trees were in bad condition when planted, 97 per cent. have made splendid growth.

GEO. W. MELCHER.

THE EASIEST WAY

WAYNESBORO. Planted 1,100 cherry trees by the use of Red Cross. Find it a very easy way, as the holes are so easy to shovel out and deep enough to put in plenty of good rich soil.

A. D. MORGANTHALER.

PHENOMENAL GROWTH

FOXBURG. Planted over 2,800 trees, using Red Cross. The growth of trees was phenomenal. To have dug the holes large enough to accommodate the roots of trees would have cost us much more than the explosives method.

HARVEY BROTHERS ORCHARDS,
By F. L. Harvey.

RESULTS FAVORABLE

ERIE. Set out 62 fruit and 100 shade trees with Red Cross and results were entirely favorable.

C. D. HAYES.

DECIDED DIFFERENCE

AVONIA. Setting out three acres of trees with explosives. Very decided difference in the growth of those in blasted holes as compared with those in spade-dug holes. Expense of explosives method only amounted to about 50 per cent. of hand method.

R. J. HOLLIDAY, Mgr.,
Idlewood Poultry Farm.

MUCH PLEASED

CANTON. Entire orchard of 2,644 trees was planted with Red Cross at an average cost per tree of about 11½ cents, including labor for rock drilling and removing old stumps. Am very much pleased with results.

L. M. MAROLE,
With Belmar Manufacturing Co.

SURPRISING RESULTS

EXTON. Planted 300 fruit trees with Red Cross. Result was surprising and pleasing. Only one tree had died, the others doing exceptionally well. Neighbor who planted without explosives lost four out of five; another planted 300 and lost half of them.

RICHARD H. TRIMBLE.

GREAT ECONOMY

NORTH EAST. Used explosives for tree planting very satisfactorily. Has proved not only a great economy in labor, but the work was done better and trees invariably made better growth.

CRAWFORD BROTHERS CO.

DROUGHT INSURANCE

MEADVILLE. Planted a number of fruit trees in blasted holes at a cost of seven to eight cents per tree. These trees withstood the drought much better than those planted in spade-dug holes.

W. S. WISE.

SAVES TIME IN PLANTING TREES

PHILADELPHIA. Planted 100 peach trees in blasted holes in one day. Ground is now very loose. Am more than pleased with results and would not plant another tree on my place without explosives.

A. F. BORNOT BRO. CO.

BETTER AND QUICKER

MT. ALTON. Used Red Cross to plant 400 trees and find it better and quicker than any other way.

R. J. GATES.

VERY SATISFACTORY

ALTOONA. Results obtained from the use of Red Cross in planting trees in City Parks were very satisfactory. Members of Park Board think it is the only practical way of doing tree planting.

E. ENGELMANN,
Member of Park Board.

REMARKABLE GROWTH

WASHINGTON. Planted 1,600 fruit trees with Red Cross. Trees are making remarkable growth and we are entirely satisfied that planting with explosives is a thoroughly practical method.

GEO. H. WARRICK,
Manager Washington Floral Co.

REDUCED COST

WARREN. Planted 1,000 trees with Red Cross. Trees are much stronger and larger than those in spade-dug holes. Use of explosives considerably reduced cost of planting. Loss of trees in spade-dug holes 16 2/3 per cent., while in the blasted holes loss was about 1 per cent.

ALEX. L. SHAW.

BEST AND CHEAPEST

ALTOONA. Am thoroughly convinced that the explosives method of tree planting is the best and the cheapest, as the soil is broken up sufficiently to permit the natural growth of the tree.

EMIL ENGELMANN,
Florist and Landscape Gardener, with P. R. R. Co.

NURSERYMEN PUSH IT

LIBRARY. Had such good results, we urge everyone to try blasting.

PITTSBURGH NURSERY CO.

SOUTH CAROLINA

REPLANTS GROW FAST

MERIWETHER. Considered replanting of peach trees in old orchards impractical until I began using Red Cross. Now replanting with great success, using Red Cross, and the trees are making as much growth in a year as they did in the old way in two or three years.

LOCUST HILL ORCHARDS,
Wm. S. Middleton.

SOUTH DAKOTA

REMARKABLE RESULTS

MITCHELL. Planted 50 trees in blasted holes on a high point where there is considerable gravel and the soil hard. The results were so remarkable that the City Park Board expects to blow 400 holes with Red Cross.

H. D. VAN BENTHUYSEN,
School of Commerce.

WONDERFUL GROWTH

WYMORE. Planted 100 one-year-old apple trees in the Spring with Red Cross that were cut off 18 inches above the ground. By late fall they were as high as an average man's head, having made wonderful growth for yearly trees.

L. BRIDENTHAL & CO.

TENNESSEE

RECOMMEND METHOD

SMITHVILLE. W. H. Davis & Son, wholesale nurserymen, frequently send us names and addresses of their customers and ask us to send them Farmers' Handbooks to give them proper instructions for blasting tree holes. Davis & Son recommend this method to their customers.

MUCH MORE SATISFACTORY

JOHNSON CITY. Planted 2,500 trees with Red Cross and a few in dug holes as a check. Those in blasted holes made a much more satisfactory growth than those planted by spade. Expect to plant 8,000 more trees with Red Cross.

R. F. BREWER, Industrial Agt.,
Carolina, Clinchfield and Ohio R. R. of South Carolina.

TEXAS

DROUGHT PROOF

NEW BRAUNFELS. Planted 40 trees with Red Cross. In spite of great drought during summer, trees in blasted holes stood green all summer and did not stop growing at all, while those in dug holes stopped growing and suffered much from drought.

OTTO LOCKE, Proprietor
Comal Springs Nursery.

VERY SUCCESSFUL

HOUSTON. Our success with explosives in planting trees has been so satisfactory that we would not think of planting trees, particularly pecans, without first blasting the holes.

F. W. COLBY, President
Aldine Fig Co.

KILLS FUNGUS

BROWNWOOD. Exploded charge of Red Cross in spot of ground infested with root rot fungus. Immediately planted a cherry tree in same spot which grew well without any signs of root rot. Believe explosion will destroy this disease within considerable distance of center of explosion.

CHAS. F. WARD, Mgr.
Arbor Hill Nurseries.

DOING NICELY

LAREDO. Have started a park in this city known as "Bella Vista Park." All the trees were planted in blasted holes and they sure are doing nicely.

E. O. STABEN.

VERMONT

A LIFE INSURANCE POLICY

SANDGATE. Soil sandy loam. Blaster, as a test, shot 250 holes in 40 minutes. Cost of labor, explosives, etc., .0309 per hole. Consider planting trees in blasted holes giving them a life insurance policy.

GEO. W. DENNEHY, Mgr.
Egg Mountain Orchards.

VIRGINIA

TREES DO BETTER

LYNCHBURG. Have used Red Cross for tree planting and find that the trees do a good deal better when the holes are so prepared.

M. N. MOORMAN, JR.

BLASTED TREES SEVENTEEN YEARS

LYNCHBURG. Have been planting trees with explosives for seventeen years with success.

R. C. DRIVER, Supt.
Park Commission.

SPEEDS UP GROWTH

CHERRYDALE. Used Red Cross for planting young trees and rejuvenating old ones. Trees planted in this manner are running away from the rest, while those cultivated with Red Cross show marked improvement over those worked in the old way.

PAUL C. BISCHOFF.

NEVER AGAIN FOR SPADE

CROZET. Am using Red Cross every day now. Bought 250 lbs. to plant 1,000 trees. Find it O. K. Shall never dig another hole for trees except with Red Cross.

S. K. GARRISON.

DID FINE WORK

STEVENSBURG. Used Red Cross to set out 600 trees and it did fine work.

H. McVEIGH.

COST LESS

RICHMOND. Planted 100 trees with Red Cross in 1911. Did not lose a tree, although summer of 1912 was very dry. Trees made vigorous growth. Explosives cost less than labor or digging holes for old-style tree planting.

R. H. JOHNSON.

ALL LIVED

WAYNESBORO. Planted 30 trees with Red Cross in April, 1911. Although summer was very dry, all have lived and done well. Balance of the orchard set out in the old way did very poorly and only a few trees lived.

W. R. BOOKER.

PHENOMENAL RESULTS

STUARTS DRAFT. Trees are far outstripping neighbors' trees planted without Red Cross. I set 300 apple and 900 peach trees in the fall of 1911. Blasted every hole. Results were phenomenal, as in 1913 all of the 1,200 trees set are living and thriving.

R. B. NUGENT.

MORE THAN PLEASED

CHARLOTTESVILLE. Planted my orchard in 1911 with Red Cross. Orchard has done finely and am more than pleased with results.

THOS. S. KELLER.

WONDERFUL GROWTH

TIMBERVILLE. In November, 1912, had dug about 8,000 tree holes and had 16,000 more to dig. Was induced to try Red Cross on remainder. While next year was very dry, trees did not suffer and made wonderful growth as a result of blasting.

J. T. KELLEY.

FAR AHEAD OF OLD METHOD

ROANOKE. Used Red Cross in planting fruit trees. Consider it far ahead of old method, getting quicker and better results.

ERNEST B. FISHBURN.

A GREAT BENEFIT

MONTROSS. The apple trees regenerated with Red Cross last year are in splendid condition and full of fruit. As 1912 was a dry year, blasting was a great benefit.

A. E. CARVER.

DROUGHT PROOF

FISHERSVILLE. Used Red Cross to set out young trees in our orchard. The practical and beneficial result of the experiment was that while the drought was distressing in the balance of the land, from two to three feet from the trunks of our small trees in blasted ground was distinctly damp.

WM. A. PRATT, Mgr.
Bell View Orchard Co., Inc.

CONCLUSIVE PROOF

TIMBERVILLE. Trees planted in spade-dug holes in my three-acre orchard failed to grow and I kept resetting them each year for three years. In every instance, trees died before they had made four inches of growth. The fourth time I used explosives to set trees. All lived and showed a growth of from 18 to 24 inches in three months, although weather was unfavorable.

CHAS. F. HIGGS.

WASHINGTON

ENTIRELY SATISFACTORY

NORTH YAKIMA. Planted 900 trees with Red Cross. Loss about 4½ per cent. In spade-dug holes loss about 10 to 20 per cent. Results in blasted holes entirely satisfactory.

JAS. W. MATSON.

MARKED BENEFIT

SPOKANE. Used several hundred pounds Red Cross in my orchard, and am convinced that the beneficial effects of this treatment are very marked. The shattering of the subsoil makes available a largely increased amount of fertility.

LOUIS A. DYAR.

ROSETTE CURED

NORTH YAKIMA. Through the use of Red Cross have gotten quick results from two trees badly affected with rosette. Both seem to be entirely cured.

F. H. HUNTER.

MARKED IMPROVEMENT

WENATCHEE. Used Red Cross in blasting orchard. Portion where blasting was done shows marked improvement over the other trees.

H. D. CLARK.

ROSETTE CURED

NORTH YAKIMA. Know from experience that the loss in planting trees with Red Cross is nil compared with the shovel and pick. I have also overcome the apple rosette by regenerating my orchard with Red Cross.

PAUL G. KRUGER.

WEST VIRGINIA

DELIGHTED

PARKERSBURG. Planted 3,600 trees with Red Cross. To say that we are delighted with new process is speaking mildly. Previous to this we had planted 5,000 trees in spade-dug holes and lost 3,500. Did not lose 1 per cent. of the trees in blasted holes.

J. MENTON CALDWELL, President
The Virginian Orchards.

GAINED TEN YEARS

WHEELING. Planted maple trees with Red Cross. When 10 years old they were as large as neighboring trees 20 and 25 years old, planted in the old way.

R. A. HANKET.

NO ACCIDENTS

PARKERSBURG. Used a ton of Red Cross in one season in orchard work without slightest accident. The loss of trees planted in blasted holes did not exceed 2 or 3 per cent. Where the trees were planted without Red Cross from 60 to 75 per cent. died.

F. P. MOATS.

New York Nurserymen Endorse Blasting

Probably the greatest nursery section in the United States is located in western New York. The centers of this industry are Dansville and Rochester. There are probably two hundred nurseries, large and small, in and around these centers.

The propagation, growing and selling of trees is the nurserymen's business. Naturally, in order to succeed, he must make a thorough study of all that pertains to the successful growing of trees. His advice as to the selection of varieties, planting and care of trees is asked by his customers and he cannot afford to make recommendations not thoroughly in accord with the best horticultural and arboricultural practice.

When a nurseryman, therefore, advises the planting of trees in blasted holes it may be safely assumed that his recommendations are based upon his best judgment and upon experience in his profession.

In order to get the views of a number of the western New York nurserymen we sent one of our representatives to interview them. Below are given brief extracts from his reports:

ROCHESTER, N. Y.

WOODLAWN NURSERIES. Believe in and encourage planting of trees in blasted holes. Requested 500 Red Cross Farmer Booklets, one to be enclosed with each shipment of trees.

ALLEN L. WOOD.

GLEN BROTHERS, INC. Believe in and advocate planting of trees in tight soils by blasting.

R. A. MAYO,
Manager.

FAIRVIEW NURSERIES. Advocate planting trees in blasted holes. Ask for booklets and price lists to distribute to their customers.

C. G. SCHOENER,
Sales Manager.

HOOKER BROTHERS. Believe in and advocate blasting for fruit trees in heavy soils or where hard subsoils exist. Asked for booklets to be given out by their salesmen.

GRAHAM NURSERY CO. Advocates planting trees in blasted holes. Promised to send us a list of their agents to enable us to send each one a supply of Red Cross Farmer Booklets for distribution to their customers.

J. M. CAMPBELL,
Secretary.

HAWKES NURSERY CO. Believes in using explosives to plant trees and recommends it whenever subject comes up.

CHAS. H. HAWKES,
President and Treasurer.

FREDERICK E. GROVER & CO. Nursery in Wisconsin. Believes in using explosives to loosen soil.

ALLEN NURSERY CO. Advocates planting of trees in blasted holes.

McGLENNON & KIRBY CO. Believes in planting trees in blasted holes. Planted 500 acres in this way at Cooleewahee plantation, Albany, Ga., and intends doing additional work in same line down there later.

CHARLTON NURSERY CO. Advocates planting of trees in blasted holes.

E. M. OSBURN,
Sec'y and Treas.

CHASE BROTHERS. Believe in use of explosives in certain soils and advocate its use. They send our booklets to those who make inquiry and whose land needs the treatment.

PHILLIPS NURSERY CO. Landscape architects. Recommend use of explosives when heavy soils are encountered.

IDEAL NURSERY CO. Advises buyers of nursery stock to loosen soil by blasting if it is heavy. Has secured several blasting jobs for the professional blaster near that locality.

F. J. BLAESI.

EAGLE NURSERY CO. Believes in use of explosives for tree planting in tight soils. Requested a supply of our booklets to use in answering inquiries.

DANSVILLE, N. Y.

KING BROS. Recommend the use of explosives to loosen up the soil previous to setting out trees in heavy and clay soils.

MARTIN KING.

ALTON E. RANDALL. Advocates the use of explosives where soil is heavy or tight.

MALONEY BROS. & WELLS. Recommend the use of explosives in planting trees in heavy soils.

W. J. REILLY. Believes in blasting soil and subsoil in heavy and tight soils and recommends it.

REILLY BROS. When customer has heavy or tight soil or subsoil, they recommend the blasting of the ground before planting.

WELLS WHOLESALE NURSERY CO. Advises customers when they ask about using explosives to plant their orchard trees that way; that it is a good thing if they have clay or heavy, tight soil or subsoil.

KELLEY BROS. NURSERY CO. Sells to large planters mostly. They advocate using explosives in tight and heavy soils or subsoils.

GEO. A. SWEET NURSERY CO. Believes in loosening the soil by blasting preparatory to setting out trees.

D. G. BANKER. Believes in loosening tight and heavy soils by blasting previous to setting out trees.

JOHN W. FINN. Believes in and advocates blasting heavy soils before setting out trees.

A. W. HARTMAN. "Knows it is the only way in tight soils."

N. W. HARTMAN. Planted 20 trees in blasted and 20 in spade-dug holes as a test. Stated that trees on blasted ground are away ahead of trees in the spade-dug holes.

SAMUEL FRASER. A fruit grower of Geneseo, N. Y., has a grove planted in blasted holes. Eight different Danville nurserymen commented favorably on the superiority of this grove over other groves in the same neighborhood.

J. B. MOREY. Advocates loosening soil for tree planting and will so advise in the tree-planting instructions contained in his new nursery catalogue.

A Customer's Letter to a Blaster

After planting 500 of our trees in the holes which you blasted with Red Cross for us, we feel it our duty to write you a letter of appreciation for the good work which you have done. We would not have had but a small part of our trees planted by this time if we had the old *spade* and *shovel,* whereas, the planting of trees is a pleasure with the blasted hole.

We have blasted out several holes for filling in our old orchards, and let us assure you that we will never entertain the thought of setting a tree the old-fashioned way, after knowing the benefits that can be realized through the use of Red Cross.. It is very evident to us that the blasted tree has by far the advantage over a tree set the old way, as the subsoil is so shattered that the tender roots will find it easy to shoot out and find the necessary foods for life, while the other tree is fighting hard to find a place to get its tender roots out of what you might call a post hole.

If you should meet any parties who have not yet realized the value of Red Cross explosives on the farm, we should be glad to have you refer them to us, as Red Cross is certainly an obedient servant, when properly used.

With kind regards to you and your family, we wish you all kinds of success.

Respectfully yours,

HICKS BROS.

Answers to Questions

When is the best time to blast ground for tree planting?

Late summer or fall when the subsoil is driest. This is true whether the trees are to be planted in the fall or in the next spring. By blasting two weeks or more before planting, opportunity is given for rains to settle the ground and fill any pothole the blast may have formed.

If, however, the blasting must be done immediately before planting, whether in fall or spring, it is entirely feasible, provided the subsoil is fairly dry, and that the blasted ground is shoveled or poled down so as to fill the pothole. The chief objection to spring blasting is that the subsoil is usually too wet to permit a good pulverization by the blast.

Will the gases from the explosive harm the tree?

No, there is nothing poisonous to vegetation in these gases, but if inhaled freely by the blaster, will cause headaches. It is very doubtful that they poison or suffocate any animal life, but the force of the blast will destroy by shock any animal life in the ground in the egg state. This explains why blasting is effective in eradicating fungus diseases, nematoid, etc.

May the holes be blasted in a garden or field containing growing crops?

Yes, without harm to any except those immediately at the spot where the bore hole is made. A tree-planting blast in dry subsoil, properly tamped, scarcely moves the surface of the ground. In fact, such blasting will benefit the growing crop by enabling its roots to penetrate new stores of food and moisture.

How can I tell whether or not the subsoil is dry enough to blast?

Shovel away the top soil, then take out a shovelful of subsoil. Squeeze some of it in the hand. If it is plastic like putty and can easily be formed into a ball, it is too wet. Or if your first blast, tamped in nearly to the top of a 30-inch bore hole, throws large chunks of earth into the air, the subsoil is too wet and you should delay blasting until some other day when it is drier.

Do you supply men to do the blasting?

No. Our Farmer's Handbook of Explosives, sent free on request, gives full instructions. But for the benefit of those who do not care to do the blasting themselves, we supply all inquirers with the names of any professional blasters in their vicinity of whom we may know whom farmers may hire by the day or job. We also furnish the address of nearest dealer and a price list of blasting supplies.

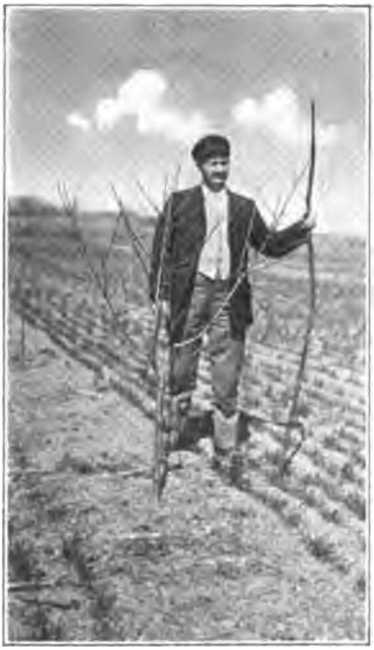
Table of Charges and Amount of Red Cross Required per Acre for Planting Trees

Distance between trees, square method	Trees per acre	Amount of explosives per acre, using ½ cart. per tree	No. 6 Blasting Caps, per acre	*Fuse per acre, 2½ ft. per tree
15 ft.	196	49 lbs.	196	490 ft.
20 "	110	28 "	110	275 "
30 "	49	13 "	49	122 "
40 "	25	7 "	25	63 "

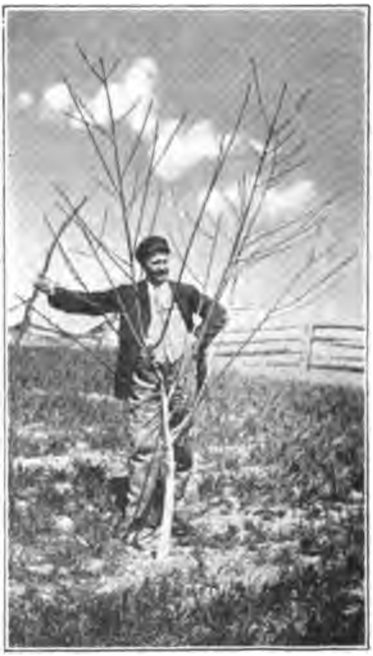
*It is necessary to have as many inches of fuse per hole as the hole is deep.

Table of Charges and Amount of Red Cross Required per Acre for Orchard Rejuvenation

Distance between trees, square method	Trees per acre	Location of holes for Explosive	Number of holes per acre	Pounds of Red Cross per acre using ½ Cartridge per hole
15 ft.	196	Midway between on diagonal lines	198	49
20 ft.	110	"	110	28
20 ft.	110	Midway between on square lines	210	53
30 ft.	49	"	91	23
30 ft.	49	Ten feet from tree on three sides	147	37
40 ft.	25	"	75	19



UNBLASTED HOLE



BLASTED HOLE

THE PROPER WAY TO SET A TREE

SOME ADVICE ON TREE PLANTING FROM THE BOOKLET OF A PROMINENT NURSERYMAN

A. Good fertile topsoil must be used about the roots. If the tree is to be planted in impoverished ground, good soil should be provided for it.

B. Plant a tree just as deeply as it stood in the nursery row. This depth is very easily determined by the dirt line always shown at the bottom of the trunk. *Failure to plant in accordance with this rule probably results in the loss of more trees than any other cause.*

C. Before planting cut off all the broken or bruised parts of roots.

D. Be sure to press earth firmly about the roots, especially about the crown, so that every particle of the roots will be embedded in compact soil.

E. A tamping stick may be used to work the soil firmly about the roots. With small trees and plants the dirt will settle firmly, if the plant is gently lifted up and down when the hole is half filled, so that the dirt will work its way between the roots. Just before filling in all the dirt press it firmly. *Be sure that the dirt is well compacted, excepting* three or four inches at the top of the hole, which should be loosened by occasional cultivation.

F. If buds have begun to swell at time of planting or if the ground is dry, watering when the hole has been three-quarters filled will not only moisten the roots, but help settle the soil firmly about them. Should drought ensue afterwards, occasional watering will be necessary until the tree becomes established; watering is, however, frequently overdone and death from this cause occurs to trees and plants almost as frequently as from neglect to water.

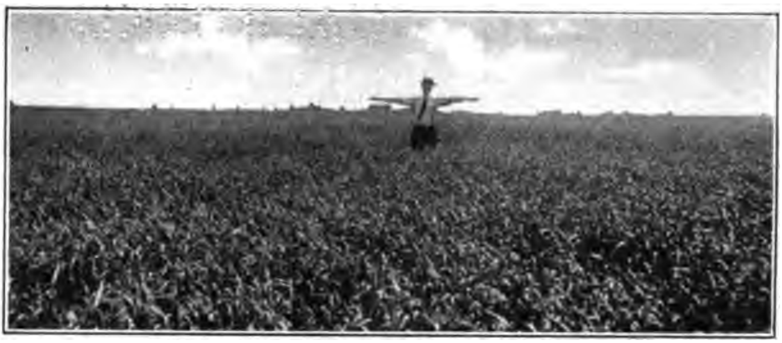
G. Trim broken or bruised branches, also two-thirds of the previous year's growth; because the roots in their disturbed condition cannot at the outset nourish as large a top growth as before they were disturbed by moving.

H. It is often best not to trim the leader or central stem, as a forked tree may result. Hardwood trees, like the oak and beech especially, should not have their central leader trimmed.

I. If the tree is large or in an especially exposed place where winds may loosen it, support it with wires and provide some protection where the wires come in contact with the tree trunk. A piece of burlap with a few sticks are useful to prevent the wires chafing the tree where they come in contact with it.

J. After planting, it is better to leave a cultivated area about the tree than to sod close to it. This cultivated area should be from three to five feet in diameter.

K. Fertilizer, in the form of stable manure or compost, may be used, but should not come in direct contact with the roots. A mulch applied after the planting is usually the best way to supply this fertilizer, as it then also acts to conserve the moisture.



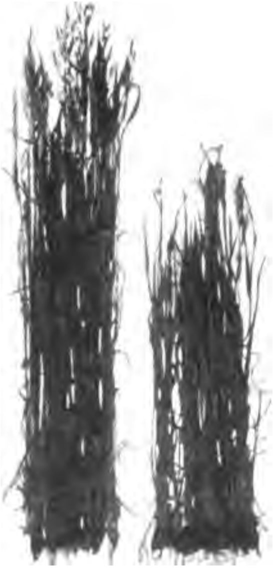
Subsoiling in Illinois

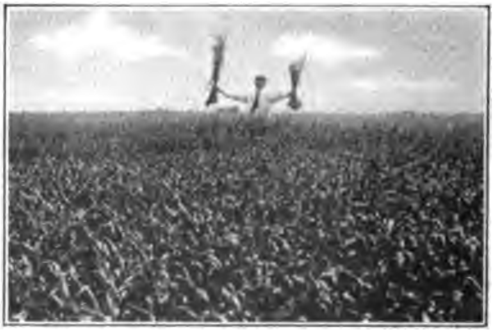
The view at the top of the page shows a field of oats near Taylorville, Ill. That part of the field in the background was subsoiled; in the foreground, it was not. Otherwise the field was prepared for planting in exactly the same way all over. The oats were planted at the same time. The dividing line between the subsoiled and unsubsoiled oats can be seen in the picture.

The man in the top picture is standing in the unsubsoiled oats; in the lower picture, he is in the subsoiled portion. Note the difference in height of oats.

The two bunches of oats that he has pulled are shown in the separate photograph at the left. The long stalks were taken from the subsoiled portion of the field: the short stalks from the unsubsoiled portion.

These pictures furnish unmistakable proofs of the value of subsoiling.





Land Drainage

The drainage of the wet lands of American farms is more important and will develop greater wealth than would be possible by operating all the gold mines in the 48 States and Alaska. There are more than 75,000,000 acres of swamp and overflowed lands, and more than 100,000,000 acres need better drainage to bring them up to a satisfactory crop-producing condition.

The extent of the individual drainage proposition varies from a few square rods in the corner of the farm to tracts of several millions of acres. Practically every farm in the heavy crop-producing areas of the United States needs some ditching, and there is hardly a stream in the entire boundary of the Union that does not need to be corrected to give better service in discharging the large amounts of waste water from heavy rains, and to protect low lands.

Drainage does not simply mean getting the standing water off of the surface of the fields. It must include the lowering of the water table in the soil to a sufficient depth to allow the natural changes in the subsoil to take place without a check, and to permit the deep-rooting of plants. Neither is possible if the soil and subsoil are choked with water. Drainage performs the double purpose of storing the greatest amount of available soil moisture and disposing of all excesses.

The mosquito pests and the attending diseases are the result of poor drainage, which renders parts of the country almost uninhabitable. Relief in this particular alone will amount to an increase in land values to several times the present selling price.

Good roads are essential in any prosperous community, but cannot be maintained without good drainage, as wet roadbeds, no matter what the surface may be, will never stand traffic. In many cases the processes of ditching and road building are carried on hand in hand with the greatest success.

Drainage includes everything from deep cultivation to permit the subsoils to absorb the maximum amount of water and hold it out of the drains, to the digging of ditches more than a hundred yards in width, and many feet deep.

Loading **The Ditch**

BLASTING DITCHES THROUGH SWAMP

Methods of Digging Ditches

The oldest and best-known method of digging ditches is with the pick and shovel, which requires much hand labor and is usually very expensive. Where very narrow ditches are needed, as for the laying of underground tile or pipes, where the ditches will later be filled with the dirt that has been dug out, either hand or mechanical diggers are used, though both methods are greatly impeded by wet soils, roots, and stumps.

For large, long ditches the floating dredge, drag-line excavator, or other heavy digging machinery finds unquestioned use, in connection with explosives for stumping and loosening heavily impacted soils and rock.

The newest method of ditching, and one that is growing in use on account of its speed and economy, is with explosives. By this means ditches from 2 to 6 feet in depth and from 4 to 20 feet in width can be excavated most satisfactorily in every type of material except loose, dry sand. The adoption of this method of ditching means a saving in time and money and in getting ditches where no other method is practicable on account of the soil conditions. The method finds ready application in everything from clear muck or heavy clay, to the worst swamp conditions where roots, stumps and an excess of water render every other method impracticable except for very large ditches where heavy machinery must be used.

No expensive equipment is needed. The outlay for explosives can be made for the exact amount of work that is to be done which relieves the need of a heavy overhead charge for money invested in equipment and tools. Ditch blasting is applicable on everything from the short ditch to drain the back field to the correction of miles of large streams.

The methods are simple and reliable, as will be pointed out in the following reports of work actually done.

The rational use of explosives will mean a saving of millions of dollars in the reclamation of the large drainage districts and in the perfection of drainage on individual fields.

Du Pont Cuts Cost in Two

ONAMIA, MINN., Aug. 9, 1911.

In regard to ditching with Du Pont will say, it's grand in wet ground. The ditch dug on my place would cost me at least 80c. per rod, and with Du Pont it was less than half; and then such quick work. One minute after loading was done the water came running in like the ditch had been there all the time. I think it was fine.

Yours very truly,
PETER PETERSON.

Ditching with Du Pont Costs One-Fourth Ordinary Method

ST. LOUIS, MO., February 8, 1912.

We take pleasure in advising you that in the month of November, 1911, we dug a ditch with Du Pont—about 500 yards long, 10 feet wide and 4 feet deep. The result was very satisfactory and gratifying, and the cost was not much more than one-fourth of digging the ditch by ordinary methods.

If you have any prospective patrons in this section of the country, will take great pleasure in giving them the facts, and if they care to, showing them the result of the ditching done by us.

Very truly yours,
ISLAND REALTY AND INVESTMENT CO.

Ten Days' Work in One Day

Relative to the ditching work on May 16th, at Vandalia, I would advise that the result was highly satisfactory to all interested.

The ditch averaged 4 feet deep and 6 feet wide at the top. Owing to the fact that the work was done in dry ground it was necessary to use a battery in connection with same. This increased the cost of the work. In the manner in which the ditch was shot, the expense averaged $1.30 per rod. Had the ground been wet the cost would have been 90c. per rod. To have done the work with teams and scrapers would have cost us $1.50 per rod and required 10 days to complete the work that was done in one day.

Yours truly,
GEO. F. SNERLY,
District Drainage Commissioner, Fayette County, Ill.

Does Four Days' Work in Three Hours

London Grove, Pa., November 6, 1911.

I am pleased to advise that I have used Red Cross for draining swamps on my property, reclaiming about one-eighth of an acre, which has always been unproductive. This is now pasture land.

This land was drained by ditching, and I found the use of Red Cross for this work less than one-third the cost of digging by hand and then hauling away the dirt. The time consumed in ditching with Red Cross required about three hours for one man, and by the old method of digging it would have taken one man at least four days. This would have left dirt on the ridge along the drain, whereas by using Red Cross it was distributed evenly along the sides.

T. S. GROFF.

Uses Red Cross in Irrigation Ditching

Billings, Montana, Feb. 17, 1912.

Last spring (1911), your Mr. J. C. Horgan made four shots on my place. The idea was to loosen up the gravel and hardpan so that the water would drain from the low ground into the drain ditch which traverses my property.

Hitherto, during the irrigating season, water would stand on low areas of my ground, and it would be necessary for me to run lateral drain ditches from the main ditch to the low spots. Mr. Horgan put holes down about five feet and charged them with one and one-half pounds of Red Cross.

This summer the ground thus shot absolutely drained into the main drain and water would not stand on it, so I can recommend this system to any wishing to overcome similar conditions.

Yours truly,
BILLINGS GREENHOUSE CO.,
By J. W. Partington.

Blasting Cheaper Than Digging

Blasted a drainage ditch for a distance of 120 rods at a cost of 43 cents per rod. The ditch was run through an old creek bottom where the ground was wet, but cross cuts were made through high dry banks, for the purpose of straightening the course. The results of this ditching were very satisfactory, the results on high ground being equally as good as on the low ground.

It would be impossible for any man to dig as good a ditch as we got, three feet by four feet, at a cost of 43 cents per rod, in the kind of soil we went through, unless he used Du Pont explosives.

JOSEPH WOLFE,
Ewen, Mich.

Du Pont Saves $435.00 for This Missouri Farmer and Increased Value of His Farm by Increasing Crops

On March 10, 1911, a large ditch was shot at Diehlstadt, Mo., on the farm of Mr. Max L. Ostner. See foot of page, showing finished ditch and water flowing through it.

The length of the ditch made was 1,720 feet. Three rows of holes, 3 feet apart each way, were drilled, the rows being staggered. The center row of holes were 3 feet 8 inches deep and the two outside rows 3 feet deep. In each of the center holes were loaded 3 cartridges, Du Pont straight 50 per cent., 1¼ x 8, and in each of the outside holes 2 cartridges. It was originally planned to fire the entire 1,720 feet of ditch with one set of primer holes, i. e., two holes in each row, these holes being loaded with an extra cartridge, containing the cap and fuse. When fired 500 feet of the ditch was cleaned out, and it developed that there was a dry sand ridge in the center of the 1,720 feet which extended about 400 feet, this preventing the entire 1,720 feet from being excavated with the one priming. A second primer group was arranged and in this shot 800 feet of ditch was made. Several extra primings were necessary to get the dry sand ridge blown out cleanly. There was about 1 foot of water in all the holes blasted with the exception of those in the dry sand ridge. The soil in the remainder of the ditch was a saturated sandy loam with some mixture of clay.

The ditch made was 16 feet wide at the top, 8 feet wide at the bottom and averaged 4 feet in depth. It was fairly well cleaned out all along.

The total cost of the ditch was $329. There were moved 3,058 cubic yards of material, costing 10.76c. per cubic yard for the entire work, against 25c. per cubic yard if the ditch had been dug by pick and shovel.

The temperature at the time of demonstration was 62 degrees F. in the sun, and 49 degrees in the shade. The temperature of the water in the holes was 35 degrees Fahrenheit.

COMPLETED DITCH OSTNER FILLED WITH WATER

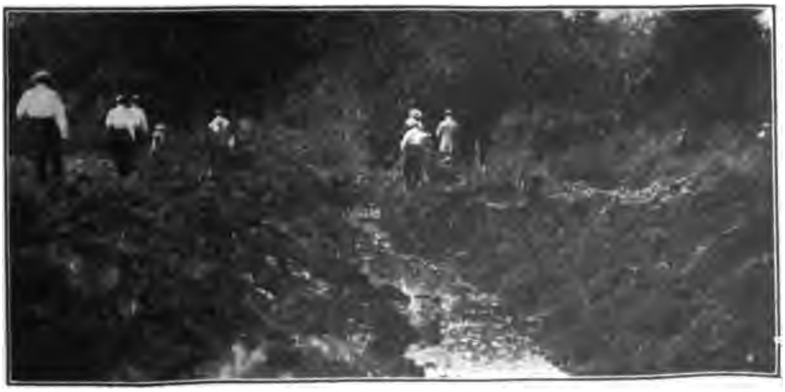
Successful Ditching on Farm of Editor of American Agriculturist

NEWBURGH, N. Y., July 18, 1911.

"The blasting demonstration on my farm last week was an emphatic success. The ditching was a complete surprise to everybody. The explosive certainly did the work and made as pretty a ditch as ever I saw.

"C. W. BURKETT."

THE BLAST



A FEW MINUTES AFTER THE BLAST

Better, Quicker and Cheaper Ditching in Difficult Material by Use of Dynamite

Rough, swamp ditching has heretofore been so difficult and expensive that millions of acres of the most fertile swamp land have been allowed to lie idle for want of better drainage. Such swamp conditions are a menace to health and greatly reduce the profitable productivity of the individual farm and of the community.

The conditions generally are aggravated by the soil being so full of water that neither men nor teams can work to advantage, and the activities of both are often stopped entirely by all the dug portions of the ditch filling with water which drains in from the soil. Mats of roots and large stumps also materially retard digging and increase the cost.

Such an adverse condition was selected in the swamp land of Georgia for a demonstration of ditching with dynamite before the Georgia Drainage Congress, at a recent annual meeting. The soil was a sandy muck saturated with water, and laced together with a luxuriant growth of roots. The surface was studded with large green gum and bay stumps. The location was selected because the managers considered it an impossible undertaking. An idea of the conditions can be gotten from the accompanying illustrations.

The line of the ditch was laid off with a light cord. Holes were punched along this, spaced two feet apart, to a depth of thirty inches. Each hole was loaded with two cartridges of dynamite; one 60 per cent. Du Pont Straight, the other 40 per cent. Red Cross Extra. A few extra cartridges were put directly under the larger stumps. The blast was fired by the propagated method, using only one cap to each section of ditch.

LOADING THE DITCH

A SHORT TEST SHOT

The result was a clean ditch 9 feet wide and 3½ feet deep, with a bottom almost absolutely true to the desired grade, at a cost of less than 10½ cents the cubic yard. The minimum estimate for hand labor on this job was 25 cents the yard, and it is quite unlikely that the work could have been done at this price.

THE FINISHED DITCH

Ditching with Explosives Endorsed by High Authority

UPPER PENINSULA STATION.
Leo M. Geismar, Supt.
MICHIGAN EXPERIMENT STATION,

CHATHAM, MICH., March 11, 1912.

I have used many tons of explosives within the past twenty years, both in removing stumps and for breaking up large boulders, but having never seen it used for digging ditches, I became interested in an experiment made in this neighborhood last summer. The test was made on a side hill underlaid with a ledge of magnesium limestone about five feet below the surface. Springs about half-way up the side hill kept the lower half of the hill and about six acres of the level ground below in an extremely wet condition. The soil is a sandy loam which contains a few small boulders and many large, flat stones thrown into various positions and weighing from 20 to sometimes over 150 pounds each. Hand digging in such ground is necessarily slow, for ditches have to be dug wide at the bottom to keep from caving in, and many large stones must be either broken up or removed with crowbars. There are several of these side hills in this neighborhood, and two men rarely average more than a rod and a half a day in digging ditches on such ground.

To cut the water off, a ditch four rods long was blasted out with explosives, the amount used being evidently more than would have been necessary, for it not only opened a ditch of ample width, but shattered nearly a foot of the solid ledge of rock in the bottom. The cost was as follows:

Explosives, caps and fuse	$3.00
1 man, 1 hour blasting	.25
1 man, 2 hours cleaning out bottom of ditch	.35
Total	$3.60 or 90c. a rod.

With two men digging one and a half rods a day and getting each $1.75 a day, the cost per rod would have been $2.33 or over two and a half times more than the cost of blasting. This demonstration convinces me that on ordinary ground, especially heavy clay, the cost of digging with explosives must be less than one-half the cost of hand digging. Furthermore, the work of blasting is done so rapidly that the advantage thereof cannot well be overlooked.

Very respectfully yours,
LEO M. GEISMAR,
Superintendent.

Endorsed by Experiment Station

We have done some remarkably efficient ditching work at a small cost (compared to teams and pick and shovel) by using Du Pont. I have in mind a piece of ditch 50 feet long, 6 feet wide, and 3 feet deep, which was dug at a cost of 12¾ cents per cubic yard. An argument that greatly favors using Du Pont in this particular kind of work is that no water-holding banks are thrown up, resulting in almost perfect surface drainage. Another feature greatly in favor of using Du Pont in ditching is the rapidity in which it can be done. When the ground is wet and heavy, and farming operations are at an enforced standstill, then is the time to do the best work in ditching—*with Du Pont.*

PAUL D. PERKINS,
Supt. Angleton Station.
Texas Agricultural Experiment Stations.

Worthless Land Reclaimed

Blasted an acre that had been under water for months, and it was almost dry the morning after the work was done. Before draining it was absolutely worthless, but is now worth $35. For years it produced nothing, but I expect to average $40 a year from the crop off this acre.

L. S. WOLFE,
Orangeburg, S. C.

8,000 Acres Reclaimed by Ditching

HERNANDO, MISS., January 15, 1912.

Your letter received this A. M. in regard to the use of explosives. I have had a very remarkable success in this line, especially in blasting stumps, ditches and hardpan.

There was a large drainage district in this county, called Hurricane Swamp Land District, comprising about eight thousand (8,000) acres of land not susceptible to cultivation. Bonds were issued to the amount of $10,000 for a ditch 8 feet wide and from 2½ to 10 feet deep. My father was interested in several thousand acres of land in this district, so he bought the bonds and carried out the contract of excavating the canal.

I was put in charge of the above work and completed the canal, using over two thousand dollars' worth of Red Cross. My first order for one thousand (1,000) pounds of 40 per cent. Red Cross made the stumps come so easy that I thought blasting the ditch was possible, so I began and in a few days could remove more dirt for $1.50 invested in Red Cross than $3 of shovel work. I made average of handling dirt at 11½c. per cubic yard, where it would have cost me 20c. to shovel same. Where the cut was more than 6 ft. negroes would not attempt to use the shovel, but wanted barrows. So here is where Mr. Negro lost out, as the Red Cross blew it out most successfully.

The above canal was in made land from 4 to 10 feet deep and required considerable boring to get under some of the largest stumps, but after the explosion I had no bother with pulling the remains off right of way. In using the stump puller it was more trouble to remove the stumps after being pulled as the dirt remaining on some of the stumps would weigh tons and had to be loosened and knocked off with the use of two (2) sticks of Red Cross. When using Red Cross a man could roll it off with little trouble right away, and without it he could have hardly pulled it off with eight yoke of cattle.

This land that was worthless is now the finest land in the county. I have used the 40 per cent. Red Cross in all of my work, and we attribute the fast coming and washing due to the use of your explosives. I hope to blast about 15 acres of my own farm between now and the 15th of March. The above work will be subsoiling, as we have a very heavy clay subsoil in this district. I thoroughly understand all the details of setting trees with Red Cross.

Yours very truly,

N. C. BANKS,
Box 14, Hernando, Miss.

Tile Drain Made Effective by Blasting

I shot 35 acres of swamp land which in former years was covered with water, many places standing a foot deep. Although there was a drain through the field, the water would not disappear because of impervious material between main drain and swamp land. The object of shooting was to break up this impervious material so that the water would drain through from swamp land to drain.

The regular method of digging a drain or several laterals from bogs to main drain would have cost me $400. Blasting with Du Pont only cost me $47, and my land has increased in value from practically nothing to $125 per acre.

W. J. SNODDY,
Billings, Mont.

TWO DITCHES BLASTED THROUGH HEAVY, STUMPY GROUND AT CHARLESTON, S. C., UNDER THE DIRECTION OF A GOVERNMENT ENGINEER. THESE WERE FINISHED BY HAND. THE TOTAL COST WAS MUCH LESS THAN BY METHOD OF DITCHING ORDINARILY EMPLOYED

Ditching Cranberry Bogs

This class of ditching differs from the ordinary because what is required is not merely a means of removing surplus water from land, but also a means of flooding the same land several times a year.

The sort of land best adapted for cranberry culture is ideal for ditching with Du Pont because wet and heavy.

The method used is by propagated blast from a central detonator, no blasting machine or electric blasting cap being required.

Twenty-Year Success in Cranberry Bog

Mr. A. J. Rider, Secretary of the American Cranberry Growers' Association, of Hammonton, N. J., writes:

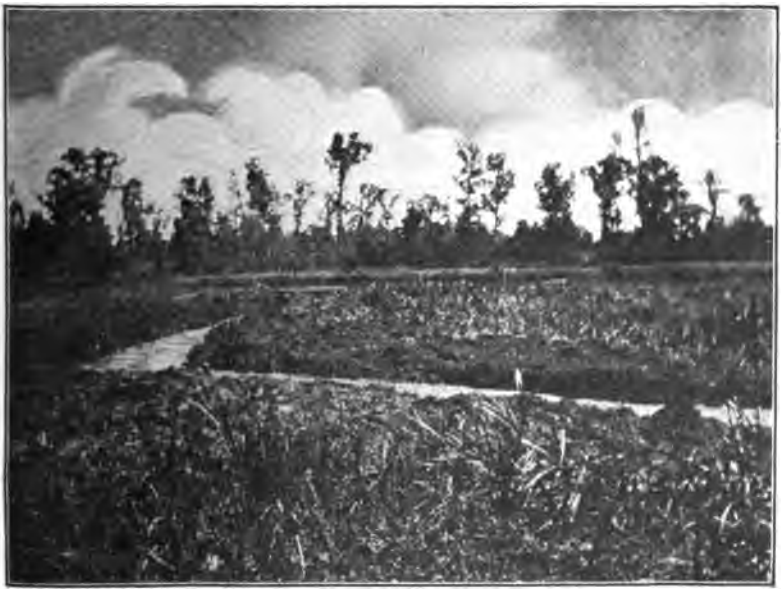
I have used Du Pont in the development of my cranberry enterprises with success and economy for the past twenty years. In removing obstructions from water courses, opening ditches and preparing the way for dams and flood-gates, it is especially useful. I keep a supply on hand at all times, and my foremen are all instructed in its use. The saving of time and labor thus effected is very great.

Du Pont will make a straight ditch and under conditions with which nothing but a dredging machine could cope. In excavating for flood-gates the mud walls are temporarily packed so solidly that water hardly seeps through. A crowbar and a stick of Du Pont will stop a leak in a dam that would otherwise require hours, and possibly days of labor. All cranberry plants are susceptible to fungus diseases, and much experimenting has been done by growers and government experts to control this enemy. Without being able to give scientific reasons I owe it to Du Pont that there has never been fungus growth at Hampton, one of my largest plantations, where I have used it freely.

If the advantages to be obtained through the use of Du Pont were brought to the attention of all large cranberry growers, I believe you would be doing them a great service

Very truly yours,

A. J. RIDER.



ONE OF THE DITCHES BLASTED AROUND A CURVE AT ONE SHOT

DITCH BLASTED WITH DYNAMITE. RIDER CRANBERRY BOGS, HAMMONTON, N. J.

ANOTHER DYNAMITED DITCH ON RIDER BOGS

Economical Stream Correction

Shallow and crooked natural stream channels are causing the inundation of much fertile bottom land. The loss in land and crops is enormous and often results in the owner of low land becoming bankrupt. The correction of such streams can be economically done by a rational use of Du Pont explosives for digging diversion ditches, to straighten the course of the stream; blowing out impeding rafts of logs and brush; scattering sandbars; removing overhanging banks, stumps and brush, or shooting out rock dikes that may be obstructing the stream.

This will result in shortening the channel by taking out the bends; and, with a clear channel will permit the eroding action of the current to widen and deepen the stream, if necessary, until it will carry the full flow.

One or more of the different troubles can usually be found in any normal brook, creek or river, and no method will give such quick and sure relief, at a small cost, than will the use of explosives.

This illustration shows what was done by Mr. W. F. Brown, of Wingo, Ky., by the use of less than $10 worth of explosives and labor. An effort had been made to straighten the stream which was flooding several acres of bottom land by hand digging. Failing in this Mr. Brown blasted out some of the tight clay and loosened the rest. A rise in the stream immediately washed out all of ground loosened by the blasts and permanently and satisfactorily corrected the channel and reclaimed the wet land. The man on the bank is pointing in the direction of the old channel.

Straightens Creek With Dynamite

YALMAR, MICH., September 21, 1911.

The ditching proposition hit me the most, and would never believe until I saw your men do it here, as the creek was making all kinds of turns and swings and cutting my farm up in an awful shape, and I could have had it done long before this if I had only known how, and with a great deal less labor and at half cost than to do it with a team and scraper. Even then it would have been very hard to get it done on account of all the roots and big stones there are in places which were easily shot out with Du Pont.

The ditch they shot here, to my measure, was 80 feet long and 7 feet wide, and 3½ at bottom, 3½ feet to 4 deep, with the cost of $2.25, which would cost me close to $1.25 per rod if I was to have it done with team and scraper or with a shovel.

CHAS. WILSON.

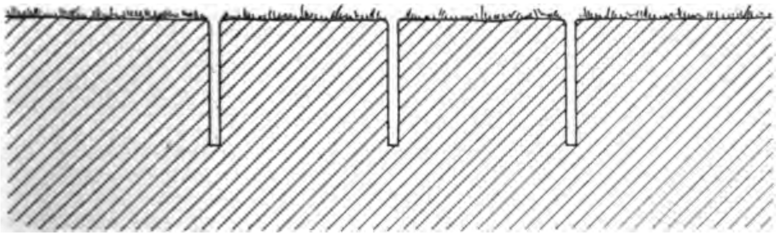
Correcting a Small Stream

The above is a view of a correction made in the course of a small stream near West Chester, Pa. The original channel was not satisfactory in that it did not discharge the flood water fast enough to prevent flooding an area of bottom land.

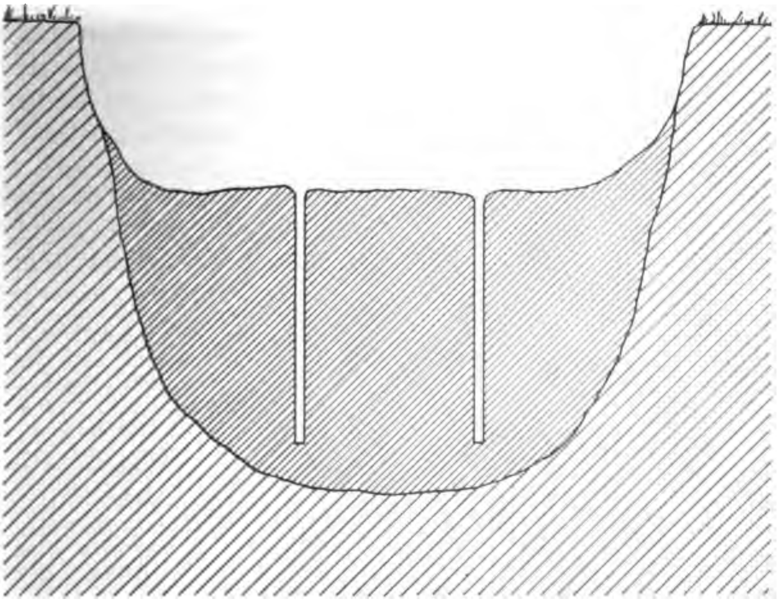
The electric method of blasting was selected and perfect excavation was secured. The new channel is entirely satisfactory. The ground was quite hard but no hand work was required to complete the ditch.

Large Ditch Successfully Blasted

At the 1913 meeting of the North Carolina Drainage Congress an effort was made to straighten a creek. The ditch needed was 8 feet deep and 18 feet wide. The surface soil was light and full of roots. The subsoil was a heavy, wet clay. Three rows of holes were put down to a depth of from 30 to 36 incnes, spaced 4 feet apart and loaded with Red Cross 40 per cent. The blast removed the soil to a depth of about 30 inches. In the bottom of this shallow ditch two rows of holes were put down, spaced 4 feet apart, to the desired depth of ditch and loaded a little more than half full of 40 and 60 per cent. Du Pont. This blast threw out the soil to the desired depth and left the completed ditch fully up to the desired size, 8 x 18 feet. The cost was between 12 and 13 cents the cubic yard, which was a little high for the work, as the loading was too heavy.



SECTION OF DITCH SHOWING HOW THE FIRST LOADING WAS DONE

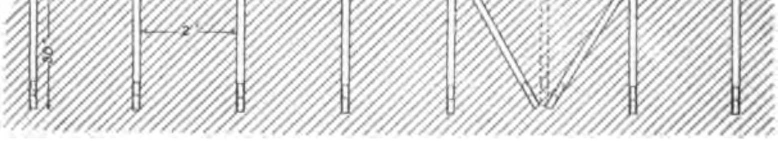


SECTION SHOWING THE BOTTOM LOADING AND THE AMOUNT OF DIGGING DONE BY EACH LOADING

VIEW OF DITCH, DESCRIBED ON PRECEDING PAGES, AFTER FIRST DEEP SHOT

The actual amount of stream correction to be done on the part of the farmer or of the community varies in different parts of the country. Where channels are to be many miles long and eighteen or more feet wide dredging machinery is ordinarily used. Heavy equipment is not economical on smaller jobs where only a short stretch of ditch is needed or where one smaller than can be economically dredged will handle the flow of the stream. In these cases there can be no better selection than that of the proper grades of explosives.

In the selection of the method of blasting, the nature of the ground and its water content as well as the size of the ditch must be taken into consideration. In another part of this book explicit directions are given for doing the different classes of blasting required for stream correction.



METHOD OF LOADING A PROPAGATED BLAST, USING EXTRA CHARGES UNDER LARGE STUMPS

Draining Ponds and Wet Spots

Often good agricultural lands are rendered worthless by shallow ponds or wet spots that are surrounded entirely by much higher land. In such cases very deep, and sometimes long ditches are needed to drain small areas, and the cost is out of proportion to the benefits.

Such wet spots are usually caused by an underlying stratum of hardpan or heavy clay, through which the water cannot drain away. If this stratum of hardpan is not too thick and overlies a stratum of open drainage material, such as sand or gravel, good drainage can be effected by blasting a hole or drainage cracks into the open material.

This work requires a careful study of the subsoil conditions, and careful loading. A detailed description of both conditions and methods is given in the Technical Supplement.

Underdrainage Increases Land Value $100.00 Per Acre

FAYETTEVILLE, N. Y., November 4, 1911.

You may be interested in learning that I had about six acres of worthless land, which was mostly bog and trash, that has been successfully drained with Du Pont.

This land was always covered with water, due undoubtedly to a stratum of shale limestone underneath, but by drilling down through this limestone from 8 to 12 feet deep at the lowest spots in the swamp, I not only succeeded in draining the entire six acres, but since then it has been planted to corn and potatoes and now to alfalfa, which is yielding as high as five tons per acre.

The cost of this draining work was about $100, including cleaning up the brush, etc., which I consider most economical. In fact, I could not have drained this bog economically excepting by the use of Du Pont.

I might also add that the value of this land has been increased from practically nothing to $100 per acre.

Yours very truly,
F. E. DAWLEY.

Perfect Results

E. I. du Pont de Nemours Powder Co., Wilmington, Del.:

GENTLEMEN:—Any one acquainted with this section of Indiana will tell you that I have a beautiful farm; that one of its proudest boasts is a fine spring and that the only blot on the farm has been a pond of stagnant water, approximately an acre, formed by said spring, there being no outlet for the water.

Recently one of your representatives suggested that he could get rid of this pond, which was a breeder of malaria, a mosquito incubator and which would greatly militate against the sale of the farm should I at any time desire to part with it. With my permission and with practically no effort, he sank a charge of Du Pont in the hardpan, exploded it and the pond disappeared. The hole that remains takes the water from the spring now "as it comes." I am thus not only rid of the one thing that marred my farm, but will soon have fine blue grass on the soil that for generations was covered by this obnoxious pond. I had contemplated laying a ditch a mile in length, that would have cost several hundred dollars, to get rid of this stagnant accumulation. The simple and successful operation by Du Pont explosives costs practically nothing.

I would advise farmers before entering upon an elaborate tile-ditching program to experiment with Du Pont. If it is possible to break through hardpan and sink water, why go to the expense of carrying it off?

Very truly yours,
C. B. LANDIS, Ex-Congressman from Indiana,
Delphi, Ind.

Land Value Increased $130.00 Per Acre

Whiteside, Kan., February 21, 1912.

In reference to the wet land shot for me by Mr. A. G. Crabb:

There never has been any water stand on this land since shooting. It cost me about fifteen dollars ($15.00), and I have had as good oats on it as on any of the field. This year it is in wheat, and the wheat looks better where the pond stood than on the rest of the field.

Before shooting this land was worthless, but I have since refused $130 per acre.

GEORGE W. SIEGRIST,
Hutchinson, Kan.

Former Pond Yields $75 Per Acre Crop

UNITED STATES DEPARTMENT OF AGRICULTURE.
BUREAU OF PLANT INDUSTRY,
Washington, D. C.
Office of Farmers' Cooperative Demonstration Work.

Morrillton, Ark., Jan. 18, 1912.

E. I. du Pont de Nemours Powder Co., Wilmington, Del.:

Gentlemen:—As per your request, I here give you my experience with Du Pont explosives as a water sinker in my field in Georgia.

I had a lime sink in my field and the water would collect in that basin and would cover about one acre and a half of ground, so some years when we had excessive rainfall I could not plant it to anything.

My brother came to see me on a visit and he said: "Why don't you put down a hole 25 to 35 feet and shoot it with Du Pont and sink the water?" So I put down a hole 23 ft. and shot it, and it sunk the water.

I weighed the corn that I gathered from the 1½ acres the first year and I got a few pounds more than 100 bushels of just as good corn as I have made in my life. This made more than $75.00, whereas I had been getting nothing from this land, besides it was very disagreeable to have to work around this wet spot each year.

That was the only year I gathered the corn separately, although it seemed to be better every year I cultivated it until I sold the farm, and I do know that the land worked better every year. This experience of mine, and the results which I secured is what makes me recommend subsoiling so strongly. Yours very truly,

JOHN W. PARLIN, Special Agent.

BLASTING THE POND SHOWN ON FOLLOWING PAGE

PLACING CHARGE FOR DRAINING POND AT NEWARK, DEL.

A FEW MINUTES AFTER THE BLAST OF POND

A Professional Blaster's Report of Some Drainage Blasts

E. I. du Pont de Nemours Powder Co., Wilmington, Del.:

GENTLEMEN:—The Severance Farm, where I blasted, has raised in value fifty dollars per acre and also the Wells Place three miles south of Hutchinson, where I blasted to drain ground, was just in small patches, but he got enough wheat off the blasted ground to pay for shooting his whole eighty acres.

As for Mr. Spankenberger, he had a big basin in the middle of his field. I went out there last February and shot fifty pounds of 40 per cent Red Cross on this five acres and in one week from the day I shot this we had six inches of rainfall (in one week) and Mr. Spankenberger rode out to his field expecting to find a pond as usual, but, to his surprise, his ground was dry, no water standing in this basin. This was a poor corn year in this country, but Mr. Spankenberger raised corn enough on this basin to more than pay for shooting this land.

Mr. Jake Siegrist, four miles southwest of Hutchinson, had a piece of land similar to Mr. Spankenberger's, and I shot fifty pounds of dynamite on it, and he raised a corn crop on it this year. Also Mr. George Siegrist at Whiteside, Kan., had a piece of land on his place of five acres that was worthless. I shot thirty pounds of dynamite on this ground one year ago, and to-day this ground is worth seventy dollars per acre.

I went up into Pawnee County two years ago and shot a piece of ground that was under water two feet deep at the time, consisting of thirty acres. I drained the water all off that ground with twenty-five pounds of Red Cross and Mr. Ford plowed this up and sowed it to alfalfa, and he has got as nice a field of alfalfa now as there is in Pawnee County.

I also blasted thirty tree holes for Mr. Friends in Rozel, Kan., and he did not lose a tree. I also blasted thirty tree holes for Mr. Smith and every tree he planted lived but one. I blasted thirty-one tree holes for Mr. Yaggar, of Rozel, Kan., and his trees all lived, and trees don't grow in this country in an ordinary tree hole.

All of those places I have told you about I have kept personal track of and I know what they were and what they are now, besides dozens of others.

Yours truly,

A. G. CRABB,
720 E. 7th Street,
Hutchinson, Kan.

One Year's Work Done in Twelve Hours.

I blasted a ditch with Du Pont, 100 rods long, 4 feet wide and 4 feet deep, through trees and net work of roots and bushes, almost impenetrable, in twelve hours. A task that two men could not accomplish in one year with pick and shovel.

Old-timers declared that such a ditch could not be dug with explosives, but seeing the new ditch full of water, and the water going through as if it had been traveling the same route for centuries, they simply had to acknowledge that ditching with Du Pont was one of the surprises of their lives, in time and expense, and every other particular.

I expect to do a lot of draining and excavating work in the near future, and will do it all with Du Pont explosives.

JOSEPH KETTLER,
Springfield, Ill.

Explanatory Note

The recommendations made in the succeeding pages are necessarily more or less general in character because this book goes into all parts of the United States.

All grades of Straight N. G. dynamite, Gelatin dynamite and such explosives as Red Cross Extra 40% dynamite, etc., can be purchased in any part of the United States.

Red Cross Farm Powder and Red Cross Stumping Powder are not for sale in the States of Montana, Wyoming, Colorado and New Mexico, and in the States west of these four. However, Red Cross Extra 20% dynamite can be purchased in any of these four States and can be used for any purposes for which Red Cross Farm Powder is recommended in this book.

Repauno Stumping Powder and Du Pont Stumping Powder, designed particularly to meet West Coast conditions, can be purchased in nearly all localities west of the Rocky Mountains. The instructions as to the use and handling of Red Cross 20% dynamite, Red Cross Farm Powder, Red Cross Stumping Powder and Red Cross Extra 40% dynamite in this book apply largely to these two western brands. In addition to using them for stumping, we advise customers in the West Coast States to use them also for tree planting and subsoiling.

Red Cross Extra 40% dynamite, which can be obtained readily in Montana, Wyoming, Colorado and New Mexico, and the States west thereof, is a favorite explosive for stump blasting, ditching with blasting machine and blockholing boulders. It can be used for all purposes for which Red Cross Stumping Powder is recommended in this book.

Explosives for Farm Use

Explosives are solids or liquids which can be changed instantaneously by a spark, great heat or powerful shock into gases having many times the volume of the explosive in its original form. Coal and wood are changed slowly into large volumes of gas by burning; water is changed into a large volume of gas (steam) by heating. This is the whole theory of explosives; and much in their use, which would otherwise seem difficult to explain, is easily understood if this be borne in mind.

Blasting explosives are divided into two classes: "High Explosives" and "Low Explosives." High Explosives, more commonly known as "dynamite," include all of the explosives which can be properly detonated only by means of an intermediate agent such as a blasting cap or electric blasting cap and not by simple ignition. Blasting powders are classified as low explosives and are exploded by a spark.

Keg of Blasting Powder

Blasting Powder

Blasting Powder is produced in granulations or grains of various sizes. It is packed in bulk in steel kegs containing twenty-five pounds. Although it is invaluable for many kinds of coal mine, quarry and general excavating, it is not generally applicable to any blasting about the farm except for splitting logs for timber or rails.

Dynamite

Dynamite differs from blasting powder in that it is more powerful, detonates with much greater rapidity, and has a greater shattering effect. The most important properties which contribute to the effect of dynamite are *strength or disruptive power* and *quickness or shattering power.* Other factors in the usefulness of dynamite are its stability or keeping qualities and such qualities as may tend to make it safer to handle. These essentials can only be secured and maintained by the use of the highest quality of ingredients, greatest care and attention, expensive and complicated machinery, skillful labor and supervision, long experience, and continued tests. The Du Pont Company fulfills all of these requirements. It has been engaged in the manufacture of explosives since 1802 and has factories in many parts of the United States. No other manufacturing concern in this country maintains a greater number of technical chemists than are engaged at the Du Pont laboratories to test daily the output of the factories to prevent deviation from standards, and to study and experiment with explosives in order to improve them.

A corps of experts in the use of explosives is maintained, not only to study the exact requirements of explosives in the various fields and differing conditions, but to demonstrate their qualities, action and use.

In line with our established policy to promoting safety in the use of our explosives, we print the word "DANGER" prominently on every cartridge of dynamite made by us.

In doing this our aim is to protect all as far as possible and particularly those not familiar with the appearance of a dynamite cartridge nor the precaution to be observed in handling it.

Such marking does not mean that our dynamites are any more dangerous than heretofore or more than competitive explosives not so marked.

The millions of pounds of our dynamites used without accident testify to our constant effort to increase their safety.

Such marking, we feel, will promote careful handling because it will indicate to the general public as well as the regular user that there is an element of danger in handling cartridges of explosives carelessly.

Responsible people can use and handle dynamite just as safely as they can handle gasoline, matches or coal oil. The energy of dynamite can be directed in the work to which it is adapted as well as the energy of steam can be directed in the work for which it is used.

Case of Dynamite

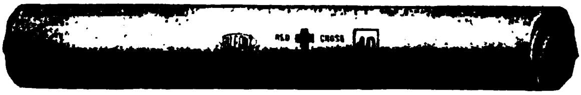
Dynamite is a solid closely resembling fine, slightly greasy sawdust, and derives its explosive power from different compounds of nitrogen. It is packed in cartridges of heavy paper, which is lightly coated with paraffin. The standard size of cartridges is 1¼ x 8 inches, each cartridge weighing approximately a half pound. Shipment is made in tight wooden cases which contain either twenty-five or fifty pounds (net) of dynamite. Where possible, users should always buy by the case, as a better price can be obtained.

Shipments are made in 25, 50, 75, 100, or other multiples of 25, pound lots.

Kinds of High Explosives

There are many different kinds of high explosives adapted to uses in mines and elsewhere, but for agricultural work Red Cross Farm Powder, Red Cross Stumping Powder, Du Pont Stumping Powder, Repauno Stumping Powder, Du Pont Straight Dynamite and Red Cross Extra Dynamite 30, 40, 50 and 60 per cent. strengths are the grades used for various purposes as explained in later paragraphs.

Red Cross Farm Powder—a slow, safe, low-freezing powder especially adapted and manufactured for subsoil blasting, tree planting, gully filling and loosening soils for road grading. It is not generally recommended for stumping or boulder blasting, although it can be used for these purposes, especially where the work is secondary to subsoil blasting.



CARTRIDGE OF RED CROSS DYNAMITE

Red Cross Stumping Powder—is a stronger and quicker explosive than Red Cross Farm Powder, and is recommended for stumping, light boulder blasting, dry ditching with blasting machine, loosening heavy soil in grading, excavating cellars or foundations. It is low freezing.

Red Cross Extra 40 Per Cent. Dynamite—has the same desirable features of all the Red Cross brands and is suitable for stumping, ditching in dry soil with blasting machine, boulder blasting, pond drainage, ice blasting, tree felling, road grading, digging post holes, blasting very hard subsoils; in short, it is a general all-around explosive that can be used for many classes of work, though the special brands hereinafter recommended are advised when they can be conveniently obtained.

Red Cross 50 Per Cent. Dynamite—is the same as the 40 per cent., with the exception of being stronger and quicker. It should be used instead of the 40 per cent. only when the work is difficult and a stronger shattering force is needed.

Repauno Stumping Powder, and Du Pont Stumping Powder, are low freezing explosives manufactured to meet the stumping conditions encountered on the Pacific Coast. They should be handled the same as the Red Cross Explosives. They are also recommended for shattering hardpan and planting trees on the Pacific Coast.

Du Pont Straight 50 Per Cent. Dynamite—is quicker and more shattering in its action than are the Red Cross brands. Its special adaptation is for blasting ditches in wet soils by the propagated method (that is, without blasting machine), for mud capping hard boulders where there is a lot of the work to do, and for digging deep post holes. It is more sensitive to shock than are the Red Cross brands, and requires more careful handling. It should be detonated with nothing weaker than a No. 6 detonator. It is not low freezing. When frozen it should be thawed only as recommended in the section on thawing. The freezing point cannot be definitely given, but is between 45 and 50 degrees F. The straight dynamites are all manufactured on the proven Du Pont formulæ and can always be depended on to develop their full strength and efficiency, and resist water well, so that they can be used in wet work.

Du Pont Gelatin—is more plastic than the dynamites, is low freezing and resists water to a marked degree. The 40 per cent. strength is well adapted to blasting ditches in sandy or loose material, and to work requiring the charges to be under water for a long time. Nothing weaker than a No. 6 cap will detonate gelatin properly.

Select the Right Grade

In several cases it will be noted in the above that two or more explosives are recommended for the same class of work. This arises from the fact that practically all grades of Du Pont explosives are very elastic in their adaptations and can be relied on for different classes of work. In selecting for a particular class of work use the explosive especially recommended, but where ordering small amounts for a number of purposes, get the one best adapted to them all, when possible.

Prompt Removal From Freight Station

The law requires prompt removal of explosives, including blasting supplies, from freight stations. Hence farmers expecting shipments should arrange with the freight agent or station master to notify them immediately on arrival of shipment, which should be removed within 24 hours.

Hauling

When transporting explosives by team always keep the wagon boxes thoroughly swept out, and when using an open wagon protect the load from sparks and rain with a robe or canvas cover. Lay the cases of explosives flat and so that they *will not shift, and never haul detonators and explosives together.*

Dynamite and detonators should not be hauled together from the dealer's or the railroad station. The detonators do not weigh much, and can be brought along on some other trip. If blasting caps are purchased from a dealer in the tin boxes separate from the wooden shipping case, it is a good plan to put these boxes in a basket or wooden box with a horse blanket, coat, hay or anything else that would keep them from being roughly jarred and shaken on the way home.

Handling and Storing

When high explosives are handled with bare hands, they nearly always cause a headache. Old gloves should therefore be worn and destroyed before they become damp and sticky and clean ones provided. A pair of gloves will remain in good condition for a long time if the explosive is handled carefully.

As soon as explosives are received they should be stored in a dry, properly ventilated building, safe from fire and flying bullets, and far enough away from dwellings or roads to prevent loss of life should they be accidently exploded. They should be kept under lock and key and where children or irresponsible persons cannot get at them. If large quantities are to be stored for some time, a dry, well-ventilated, fire-proof and bullet-proof magazine, located in an out of the way place should be provided. Fuse, wire, thawing kettles and blasting machines may be stored in the same building with the dynamite, but blasting caps and electric blasting caps *must never be stored* in the same building, because they are more easily exploded than dynamite. It would be possible to explode them accidently by a hard shock or jar which would not explode dynamite. If detonators were to explode by themselves, they would not be likely to do much damage unless there were a great many of them, but if they were to explode in the same room with dynamite, they would probably cause the dynamite to explode.

Opening Cases

When ready to use the dynamite, open the box or case with a hardwood wedge and a mallet, and take to the work, in a dry box or basket, the number of cartridges required immediately. Never take more than the day's supply even in warm weather, and in cold weather, take only as much as can be kept thawed until it is to be used, unless there are arrangements for keeping it thawed where the blasting is to be done.

Avoid Confusion

As soon as holes are ready for the dynamite—and when possible the holes should all be ready before the dynamite is brought to the work—the priming, charging, tamping and firing should be carried on as rapidly as possible without becoming careless.

A very little practice will put you in the way of doing blasting quickly, systematically and economically, and you will wonder how you ever got along without dynamite.

Thawing

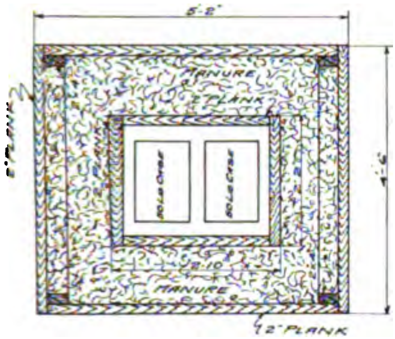
Some kinds of high explosives freeze at about 50 degrees Fahrenheit and detonate imperfectly, if at all, when in this condition. Even when chilled they cannot be depended on to work well. The different low freezing explosives described are exceptions to this rule, for they will not freeze until the weather is quite cold. Frozen dynamite is easily recognized because it is hard and rigid.

If, after the thawed dynamite is ready to use, something causes a delay and it becomes chilled or frozen before it can be put into the borehole, it should be thawed or warmed again. It does not harm dynamite to thaw it many times, provided this is done in the right way.

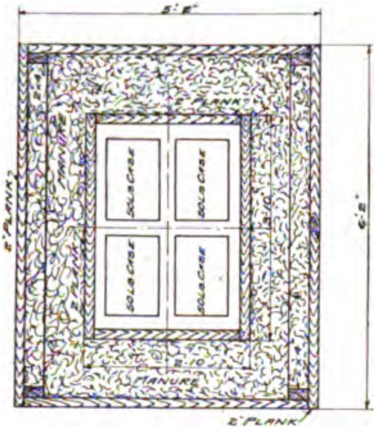
Red Cross, if loaded in the ground below the frost line and properly tamped, will not freeze again, but other dynamite may chill or freeze almost immediately when loaded in cold ground, which makes it necessary to detonate it immediately after charging. It is this that makes Red Cross so valuable in cold weather.

Du Pont Thawing Kettle

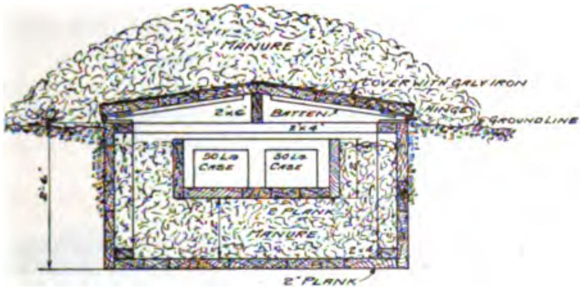
The best way to thaw dynamite, and to keep it thawed until it is to be used, is in a thawing kettle made for the purpose. It may be thawed by leaving it spread out on a shelf in a warm room (not in a dwelling) over night, or by burying it, while in the case, in green manure. It may also be thawed by putting it in a covered, water-tight pail and hanging this pail in warm water and it may be carried to the work in a dry box if covered with an old coat, a piece of blanket or something of the kind to keep it warm. It is exceedingly dangerous to try to thaw dynamite in front of an open fire, or in hot sand, or ashes, or on hot stones, or metal or steam pipes, or in an oven, and it is in attempting to thaw dynamite in some of these ways that accidents frequently happen. Do not attempt to thaw dynamite by putting the cartridges in hot water or by turning a jet of steam on it.



PLAN
FOR
TWO 50LB. CASES.



PLAN
FOR
FOUR 50LB. CASES



SECTIONAL ELEVATION
FOR
TWO & FOUR 50LB CASES

A PERMANENT MANURE THAWING BOX FOR DYNAMITE CAN BE EASILY BUILT ACCORDING TO THESE PLANS

The Du Pont Thawing Kettle is made in one piece with an outside jacket for the hot water. The No. 1 size holds 30 pounds of dynamite and No. 2 size 60 pounds.

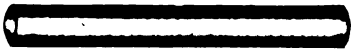
The water must never be heated in the kettle, but must be heated in some other vessel, and when not too hot to burn the hand, poured into the water compartment when the dynamite compartment is empty. It is dangerous to heat the water in the Du Pont Kettle even when the dynamite section is empty, because there may be a little nitroglycerin in it which has soaked out of the dynamite previously thawed. Dynamite should not be put into the thawing kettles without first carefully wiping out the dynamite compartment clean and dry.

Do not place a thawing kettle over a fire while it contains dynamite.

Du Pont Blasting Caps

Du Pont Blasting Caps are the big brothers of the primers in a gun shell—many times bigger. The No. 6 cap, which is the size recommended for detonating most high explosives, is a copper cylinder 1½ inches long and a little less than ¼ inch in diameter, closed at one end and loaded with 1 gram of a fulminating mixture. The No. 8 size is longer and contains a heavier charge. Nothing smaller than a No. 6 should ever be used with any of the explosives used on the farm because they:

Insure complete detonation.
Increase the execution of the explosive.
Offset to some extent deterioration, due to improper storage.
Prevent the loss of the charge by burning.



A DU PONT BLASTING CAP

BOX OF DU PONT BLASTING CAPS

Blasting caps are put up in tin boxes containing 100 caps. From 5 to 50 boxes are packed for shipment in wooden cases. They may be exploded by shock, heat or sparks, so must be kept away from fire. They are weakened by moisture and therefore must be stored in a dry, cool place.

CAP AND FUSE

Caps are used only in connection with safety fuse, to which they must be securely fastened. This should be well done with an approved Du Pont Cap Crimper described on the following page.

Fuse

Safety Fuse is a thin chain of powder, wrapped in a covering of jute or cotton yarn or in tape. Its purpose is to bring the spark to a cap used for detonating a charge of high explosives. Many grades are made for different purposes. The ones most used for farm work are Charter Oak, and Beaver for dry or moist work, and Crescent for wet work.

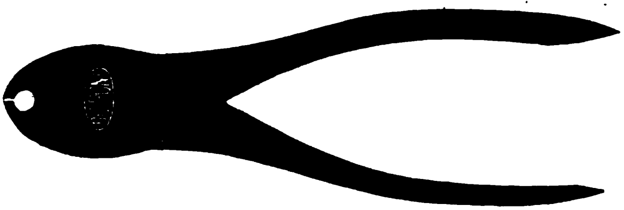
ROLL OF SAFETY FUSE

Fuse is packed in a double roll, one fitting inside the other, each 50 feet long. Each double roll of 100 feet is wrapped separately. It is packed for shipment in wooden cases containing from 500 to 6,000 feet.

Fuse should always be kept dry and should be stored in a cool, dry place. If stored in a damp place it becomes damaged after a time and may fail to burn. If stored in a hot, poorly ventilated place, as for example, close under the roof of a small shed in summer time, it may be damaged either by becoming soft and oily or by drying out and becoming so hard and brittle that it will break when unrolled. Fuse also may become stiff and brittle in cold weather, and when in this condition should be warmed before being unrolled.

Cap Crimpers

Du Pont Cap Crimpers are made especially for fastening caps to fuse and are necessary wherever blasting is done with cap and fuse. Caps are often crimped by other means, which are dangerous and unsatisfactory. The crimper now sold by this Company is the result of years of experimentation, and is the best ever offered the public.



DU PONT CAP CRIMPER

Du Pont Electric Blasting Caps

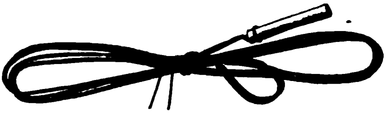
These, like the cap and fuse, are for detonating charges of high explosives. The explosive charge is contained in a copper cylinder quite similar to the ordinary blasting cap, but the explosion is caused by an electric spark brought along a pair of small copper wires instead of a powder spark from fuse. In strength they are the same as the ordinary caps of the same number. The No. 6 strength is the one adapted to farm work.

It is only by the use of electric caps that a number of charges can be fired at the same time, so they must be used in ditching in dry

BOX OF DU PONT ELECTRIC BLASTING CAPS

ground, in blasting large stumps and boulders, or any other work requiring a number of simultaneous explosions.

Du Pont Electric Blasting Caps, like blasting caps, can be exploded by shock or heat, and therefore must be handled in exactly the same way. The same precautions regarding storage and handling as given for blasting caps should be strictly observed. Never attempt to pull the wires out of their setting or investigate the contents of Du Pont Electric Blasting Caps.

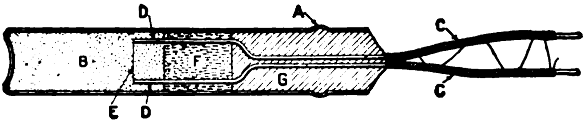


A DU PONT ELECTRIC BLASTING CAP SHOWING WIRES

Besides the advantageous properties of the No. 6 Blasting Caps, as enumerated, No. 6 Du Pont Electric Blasting Caps reduce the chances of misfires, save time, eliminate delayed or premature explosions and in a good many instances save dynamite.

The wires attached to the caps range in length from four feet to thirty feet, but it is seldom that anything longer than a four or six-foot length will be needed in farm work.

These lengths are packed in lots of fifty in strong paper cartons. Ten cartons are packed in a wooden shipping case.

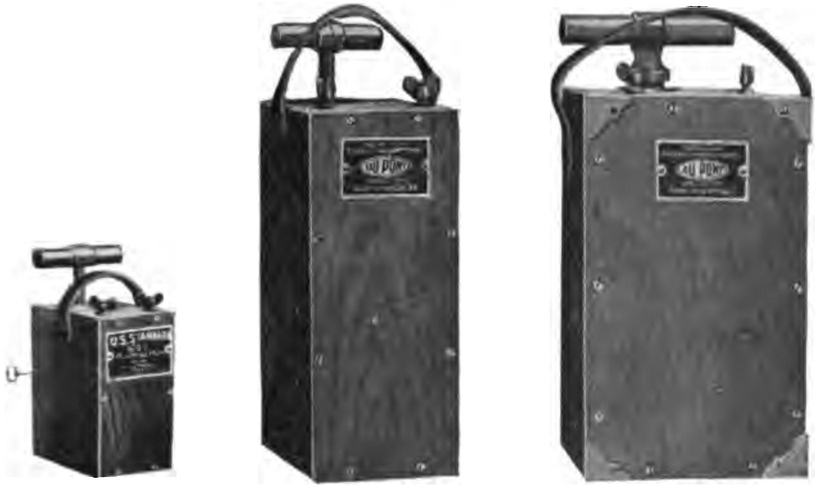


ELECTRIC BLASTING CAP (CROSS SECTION)

"A" is the shell of copper, having a corrugation thrown out from the inside, which holds the filling material more firmly in place; "B" is the chamber containing the explosive charge; "C" the insulated copper wires entering the cap; "D" the bare ends of the copper wires projecting through the plug into the charge; "E" the small platinum wire or "bridge" soldered to and connecting the two ends of the copper wires which is heated by the electric current; "F" the composition plug holding the wires firmly in place; "G" the filling material.

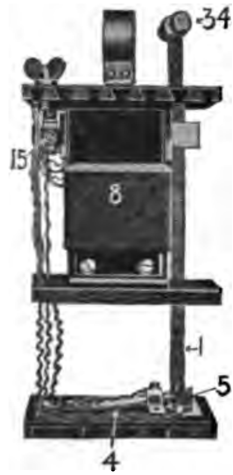
Du Pont Blasting Machines

Du Pont Blasting Machines are small, portable electric generators built for generating current to fire electric blasting caps. The mechanism is operated by a rack bar or plunger protruding through the top of the machine. When operating this bar is pulled up as far as possible, and then forced down with a quick, hard thrust. This sets in motion the armature and builds up the current until the bottom is reached, when the connections are automatically completed and the current flows out through the leading wires to the electric blasting caps placed in the charges of explosives.



No. 1 No. 3 No. 6

RELATIVE SIZES OF DU PONT BLASTING MACHINES



Working Parts of a Blasting Machine

In practical operation the machine should be placed on a firm or solid place to prevent both machine and operator tipping over.

The current is conducted from the machine to the blast by copper wires attached to the two wing-nut binding posts on the machine. While the machines are built for rough use and every precaution is taken to make all parts strong, they are likely to be damaged by exposure to the weather, and should be wiped off and put in a dry place when no longer in demand.

Blasting machines should be tested occasionally with a Du Pont Rheostat, to be sure that they are working up to standard capacity. A full description of the Rheostat and its use will be sent on application.

Du Pont Blasting Machines are built in five sizes so that a selection can be made to suit the demands of all classes of work.

Sizes and Capacities of Du Pont Blasting Machines

Size of Machine	Capacity—Number of Electric Blasting Caps Copper Wires	Used For
No. 1	1 to 5	Stumping and boulder blasting.
" 2	1 " 10	Stumping, boulder blasting, and small ditch jobs.
" 3	1 " 30	All classes of general work.
" 5	1 " 100	Large ditches.
" 6	1 " 150	Large ditches.

For stumping, boulder blasting, loosening soils to assist digging and similar work the No. 2 machine will be found entirely satisfactory. Larger blasts having an increased number of charges will require a larger size, but those larger than No. 3 are seldom needed except on large contracting jobs. Even very long ditches can be blasted in sections with the No. 3 machine.

Leading Wire

Leading wire is insulated copper wire for conducting the current from the blasting machine to the blast. The Du Pont leading wire has a strong insulation especially suited to the rough usage it must receive. It is sold in coils of 200 feet, 250 feet, 300 feet and 500 feet. There are two kinds, Single and Duplex. In the Duplex Wire, the two wires are bound together. Single Leading Wire weighs about two pounds to the hundred feet, and Duplex Leading Wire weighs four pounds to the hundred feet. Leading Wire is sold by the pound. The double wire will be found most satisfactory for stumping and boulder blasting and the single wire for ditching.

Du Pont Leading Wire

Du Pont Connecting Wire

Du Pont Connecting Wire

Connecting wire is used to complete the circuit when the holes or charges are placed too far apart for the electric blasting cap wires to reach. It is sold in one and two-pound spools. A one-pound spool of No. 20 wire holds about 210 feet.

Use of the Galvanometer

The Du Pont Company manufactures an instrument for testing blasting circuits, called the Du Pont Galvanometer. This is a very ingenious and useful instrument, and saves much time in locating breaks in electric circuits. For instructions as to its use ask for our Galvanometer Booklet.

Tools Used in Agricultural Blasting

The tools needed for agricultural blasting are very few and simple. They are often to be found on the farm, but if not they can be quickly made at little cost by a blacksmith. An elaborate outfit is seldom needed even on the large jobs.

Tamping Stick

The tamping stick is used to try out the holes before loading to see that they are properly placed and to a sufficient depth, and not stopped up, and to tamp soil on top of the charges. It must be of wood, with no metal parts. Its length should be a little greater than the depth of the holes to be loaded, and its diameter not smaller than that of a cartridge of dynamite, 1¼ inches.

HOME-MADE TAMPING STICK

An excellent one can be made of an old hoe, rake or shovel handle, or when a very long one is needed, from a sapling.

Subsoil Punch

For driving holes for subsoil blasting, tree planting, for ditching in hard soil, and for road grading, a subsoil punch will be needed. This should be of 1½-inch round or octagonal steel, and a few inches longer than the depth of the holes. The point should be drawn out in the shape of a rather blunt pencil point. This is driven into the ground by means of heavy hammers or sledges.

STEEL SUBSOIL BAR

Crowbar

A crowbar will be found convenient for making holes under stumps and boulders, for ditch blasting, and occasionally for subsoiling or tree planting.

A satisfactory crowbar for this work can be made out of an old buggy axle by cutting off one spindle and forging a wedge or chisel point.

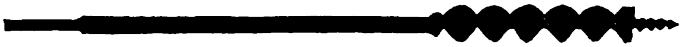
Soil Auger

The soil auger is used for making holes for stump and boulder blasting, for deep drainage, and for other holes hard to make with a punch. While it can be used for subsoiling it is not as fast as the subsoil punch. It should be 1½ or 2 inches in diameter.

The bit may be welded to a solid steel shank that will make the auger at least five feet long, if for stump or boulder blasting. For deeper work the shank can be made of ⅜ or ½-inch gas pipe in sections of 2 or 3 feet long, so that it can be extended by adding more sections. The handle is made of a pipe "Tee" and two short pieces of pipe for handles.

A good type of auger head can be easily made by a smith. The shank is flattened out and welded into a sleeve socket. The handle proper should be of wood and only long enough to make turning easy.

Worn-out wood augers make fairly good soil augers for small jobs, but where there is much work to do it will pay to get the special soil augers shown below.



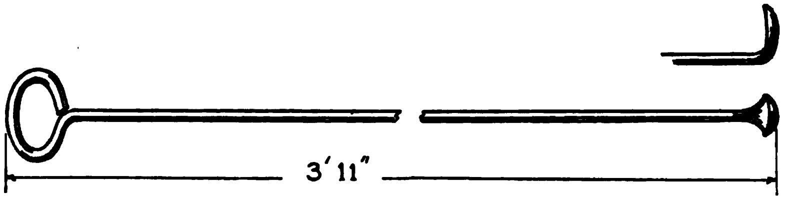
SOIL AUGER BIT

Wood Augers

Wood augers are used by the blaster for boring into the tap roots of fat pine stumps, and for log and stump splitting. They should be both heavy and sharp. The shank for stump blasting should not be less than five feet long.

Spoon

A blasting spoon made by flattening and cupping the end of a ¼-inch steel rod, as shown in the accompanying cut, is very convenient for enlarging bore holes, removing pebbles from holes, and for removing tamping from misfired holes.



A GOOD TYPE OF SPOON

Other Tools

Heavy hammers are needed to drive the subsoil punch, and a mattock and shovel can be used for a number of purposes. For block holing rock a hand drill and hand hammer will be needed.

Principles of Blasting

When dynamite or other high explosives detonate—the small volume of solid is converted immediately into a volume of gas many times greater than the solid. If the explosive is unconfined the expanding gases will waste themselves in the air, but if it is confined there is a great pressure exerted on the holding material, which if not too strong, will be shattered or blown away.

The force of the gases is equal in all directions. If the desire is to blow a boulder or stump into the air the charge is placed below the object. The best shattering is obtained if the explosive is placed in the material to be broken so that the force is exerted on it equally in all directions. This is applicable in blasting soils and block holing boulders or in splitting stumps.

While the gases exert an equal pressure in all directions they try to escape by the easiest route or along the line of greatest weakness. If the tamping is omitted or is insufficient the tendency will be to blow out through the bore hole. If a hole is placed to the side of a stump the tendency will be to blow out through the more easily lifted soil. The aim should always be to make the easiest way out directly through the material to be moved or shattered.

Detonation

As has already been explained, dynamite is fired or "detonated" by means of the shock from a blasting cap or electric blasting cap, either of which is known as a detonator.

In order that the detonation may be complete, or in other words, that the full strength of the explosive be developed, the detonator should be placed inside the charge, with its closed or "business end" pointed toward the main bulk of the charge.

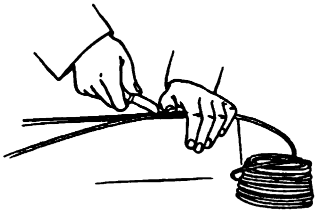
Priming With Cap and Fuse

The act of placing the detonator in the charge is known as priming and the cartridge of explosive with the detonator in it is called a "primer."

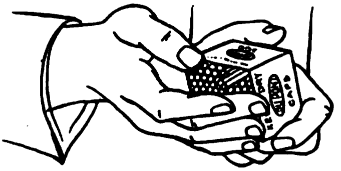
In the preparation of the primer, when using fuse and blasting cap, examine your dynamite and see that it is not frozen. Frozen dynamite is hard and rigid, and dangerous to handle; when thawed it is soft. Next examine your fuse, see that it is not stiff and brittle; if in this condition it is advisable to warm slightly and cut the required length from the roll with a sharp knife or pruning shears. The cut should be made squarely across and not diagonally. Sometimes in the cutting the end becomes flattened, thereby making the end of the fuse too large to enter the blasting cap. When this happens squeeze the end round with index finger and thumb, open the cap box and allow one cap to slide gently into the open hand, but under no circumstance pick a cap out of the box with a piece of wire, stick, or other hard substance. See that there is no grit or trash in the cap. Slip the end of the fuse gently into the cap until it is against the charge in the bottom. Do not twist the fuse as the friction might cause a premature explosion. Then take the cap crimper and fasten the cap to the fuse with a crimp near the open end of the cap. These operations are not dangerous but should be done carefully. If the primer is to be used in a wet hole smear a little hard tallow, soap or similar substance, but not grease, around the top of the cap to insure against water leaking in and ruining the cap before it is fired. The cap is then ready to be inserted into the dynamite.

There are two reliable ways of doing this; in the side and in the end. To prime in the end of a cartridge, fold back the paper shell, punch a hole at least two inches deep and ¼ inch in diameter straight down into the dynamite, insert the cap and fuse, fold back the paper and tie it firmly with a short piece of strong twine. This method has the advantage of having the cap pointed directly into the charge. It is graphically represented in the illustrations on the following pages.

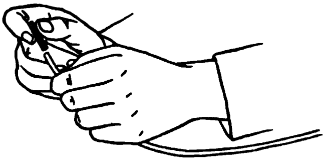
The other method is to punch a hole diagonally into the side of the cartridge, near the end and pointing toward the center, to a suf-



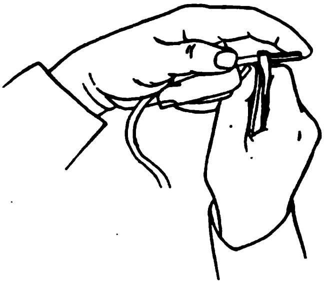
1. Cut off a sufficient length of fuse.



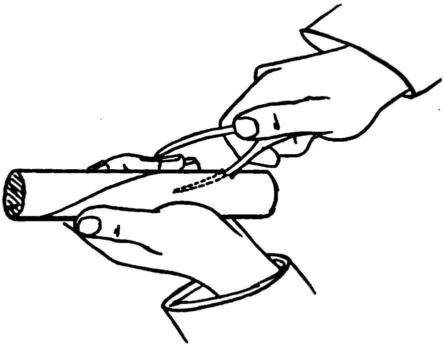
2. Take one cap from the box with the fingers.



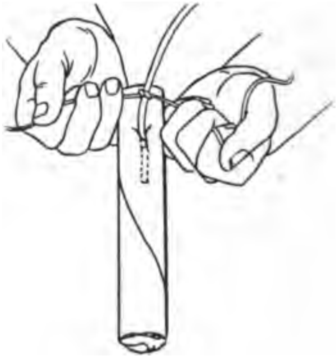
3. Slip cap on end of fuse.



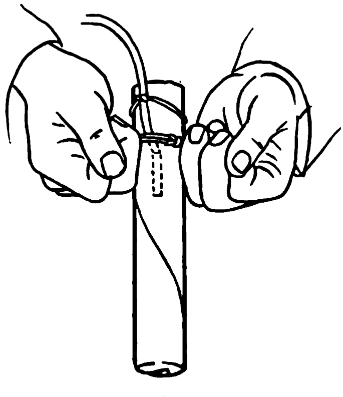
4. Crimp cap to fuse with cap crimper.



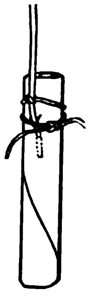
5. Punch a hole in side of cartridge with handle of cap crimper.



6. Tie cord around fuse.

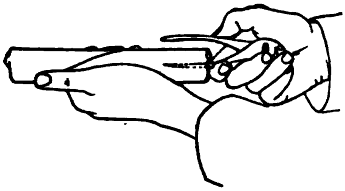


7. Complete by tying around cartridge.

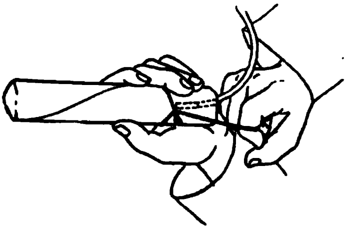


8. Completed primer ready to load.

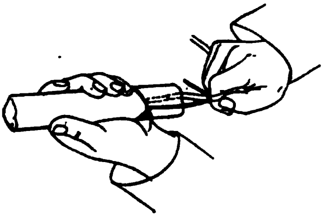
MAKING UP A PRIMER



1. Punching hole with handle of cap crimper.



2. Tie cord around cartridge and



3. Then around fuse.

PRIMING IN END OF CARTRIDGE

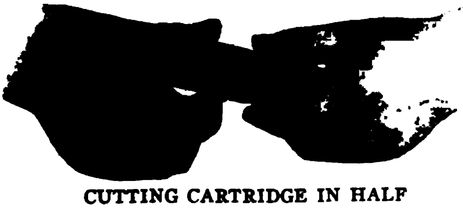
ficient depth to receive the entire cap. Insert the cap with fuse attached and tie it there with a piece of cord. This method has the advantage of leaving a good place to apply the tamping stick in seating the primer in the hole, and is graphically illustrated above.

The holes can be punched in the dynamite with the handle of the cap crimper, or with a wooden awl, and should always be deep enough to receive the entire cap and about ¼ inch of fuse.

When the primer is to be of only half a cartridge, as in subsoiling, it is good practice to punch a hole in each end of the cartridge and cut the cartridge in two before inserting the caps.

Cutting a Dynamite Cartridge in Half

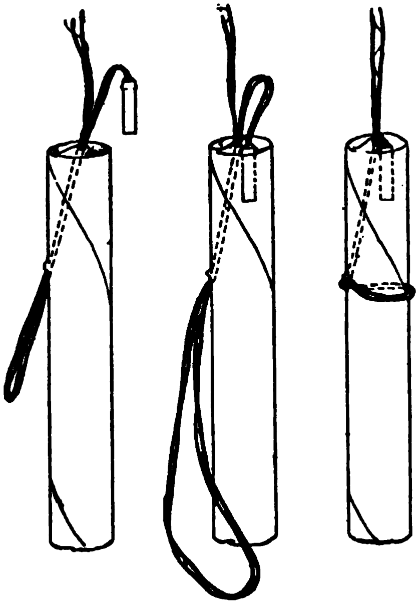
When small charges are desired it becomes necessary to cut cartridges in half. This should be done with a sharp knife. Hold the cartridge firmly in one hand and the knife in the other. Giving the cartridge a rotary motion, cut the paper all the way around and then bend the cartridge slightly, when it will come apart just where the paper is cut. Never try to cut a frozen cartridge.



CUTTING CARTRIDGE IN HALF

Priming With Electric Blasting Caps

When electric blasting caps are used they may be inserted into the dynamite as has been described for cap and fuse. Many blasters, however, prefer to use a slightly faster method, which has been found entirely satisfactory.



Punch a hole from the center of the end of the cartridge in a slanting direction so that it will come out at the side 2 or 3 inches from the end, insert the end of the doubled over wires of the electric blasting caps, loop these around the cartridge after which another hole is punched in the top a little to one side of the first and straight down. The capsule is inserted in this last hole as far as possible and the slack taken up on the wires, with the result that you have a primer where the wires do not cross each other at any point and the capsule is lying nearly in the axis and the cartridge hangs vertically, so that it is possible to load in the bore hole without its being caught on any roughness.

Never half-hitch the wires around a cartridge of dynamite, and when using cap and fuse never lace the fuse through the dynamite.

Loading

When the cartridge is primed and the bore hole made, the next thing to do is to load. First try the hole with the tamping stick to see that it is open and will permit the charge being placed at the desired point.

When loading small charges, as when only a full or half cartridge primer is used for subsoiling or tree planting, start the primed cartridge into the bore hole and press it gently into place with the tamping stick. See that it is firmly seated in the bottom of the bore hole.

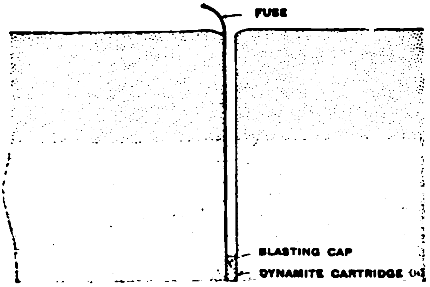
In pressing a primer into place, do not handle it roughly, as it contains the cap and is, therefore, more sensitive and dangerous than an unprimed cartridge.

When the load is to contain a larger amount of dynamite, press the unprimed cartridges in place in the bottom of the hole first, and place the primer with the cap pointed toward the rest of the charge on top. When the bore hole is dry, and it is desirable to have the charge concentrated in one place, it is a good practice to slit the sides of the cartridges with a knife or remove the paper entirely so that the dynamite can be compacted into a smaller space. The primer itself should not be split.

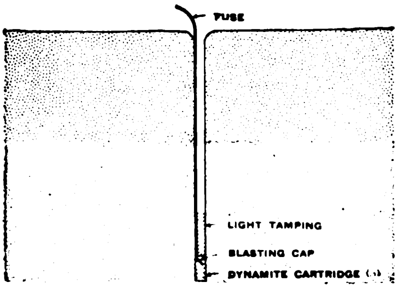
Tamping

Closing the top of the bore hole after the charge is placed is for the purpose of more closely confining the charge to insure better work and is called "Tamping." It should be made as tight as possible, so that the gases will not blow out as through the muzzle of a gun.

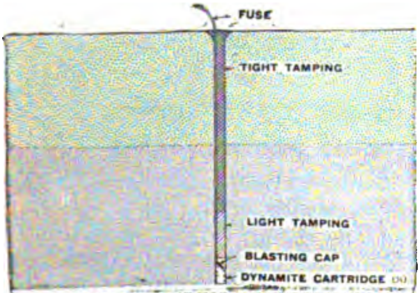
To guard against danger of prematurely detonating the charge, the first 5 to 8 inches of tamping should not be packed with any considerable force, but should be gently firmed. When this amount of lightly tamped material covers the primer, the rest of the tamping should be made as hard as possible, using the wooden tamping stick in one hand.



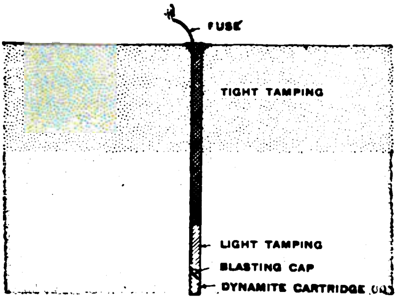
PRESS CARTRIDGE DOWN GENTLY; DON'T POUND



PUT IN 3 TO 5 INCHES OF EARTH AND TAMP LIGHTLY



TAMP FIRMLY TO THE TOP AND IT IS READY TO FIRE



LIGHT FUSE AND RETIRE TO A SAFE DISTANCE

Moist clay, free from gravel and clods, makes good tamping material. Free running sand or moist loam is also good. In wet work, when a foot or more of water covers the charge in shallow holes, it will not be necessary to add other tamping, as the water will hold the charge sufficiently tight. Loading and tamping should be done in such a way that no open-air spaces are left.

When using soil for tamping, the hole should be tamped full. Do not allow sharp pebbles or stones to fall in the hole during loading and tamping.

Before beginning tamping it is well to measure the depth from the surface to the top of the charge, so that if the tamping must be removed to get at a misfire there will be no danger of disturbing the primer. It is a good practice, especially where heavy charges are used, to use two inches of paper or dry leaves for tamping immediately over the primer, so that they can be used as a safety marker, should the tamping need to be removed for any cause.

Firing

Exploding the charge is called "Firing," and can be done either by caps and fuse or by electric blasting caps. When cap and fuse are used cut the fuse long enough to enable you to retire to a safe distance. Fuse burns on an average of two feet per minute and a sufficient length should be used to permit of the blaster reaching a safe point before the explosion. When using electric blasting caps the leading wire should be long enough to enable the one who operates the blasting machine to be outside the danger zone. No blast should be fired until persons, animals and vehicles are well out of range.

When reliable explosives and blasting supplies are used, and the primers properly made and placed, misfires should seldom occur. When using cap and fuse, and a misfire is noted, do not return to examine it at once, as an injured fuse may be burning slowly and delaying the shot. It is better to wait until the next day, if possible.

When using electric blasting caps there is less danger of delayed shots or misfiring. When one does occur, disconnect the wires from the blasting machine, and it will be safe to return immediately to the blast for investigation. Never connect the wires to the blasting machine until it is time to fire, and guard against a careless person tampering with the machine and leading wire while loading shots.

In selecting a safe place to watch a blast, do not get behind a tree or building, but stand in the open at a safe distance from the blast, so that you can see the flying fragments and dodge any that may come beyond reasonable bounds. Do not have the sun in your eyes, as it may obscure flying missiles.

What to Do in Case of Misfires

Avoid misfires by using good dynamite and detonators, and make and place primers carefully. Should a misfire occur with cap and fuse, wait, as already advised. When it is definitely known that the blast has failed, the treatment will depend on the individual shot. If it is in wet soil, carefully place another primer close enough to detonate the charge. This is very easy in water-tamped holes, as the new primer can be placed on top of the old one. In dry soil or rock, the tamping can be removed in order to get a new primer in close proximity to the old one if extreme care is observed. The tamping should be loosened with a hardwood stick, whittled to a point and removed with a spoon, such as the one described in figure on page 136. If the depth of the tamping is definitely known, an auger slightly smaller than the bore hole can be used until near the charge. Sometimes it will be best to put down a new hole sufficiently near the old charge to blow it out along with the confining material. Such a new hole should not be closer than two feet, and care should be used in putting the hole down to insure that the old charge is not disturbed.

If electric blasting caps are used, carefully examine all connections and see if any of the wires are broken or if there is any grounding.

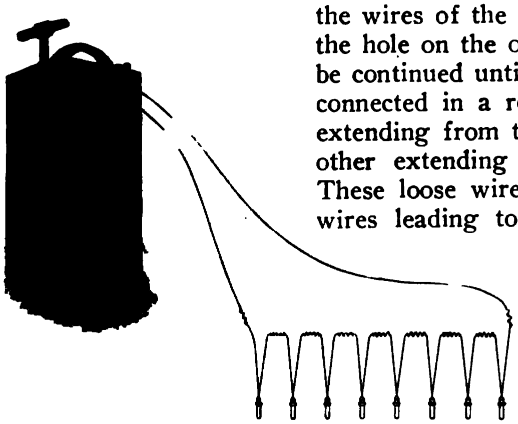
Blasting by Electricity

Large boulders and stumps with spreading roots can often be blown out and broken up more thoroughly and with less dynamite if the charge is distributed in several holes in different places under the boulder or stump and all of these charges exploded at one time. Groups of stumps standing close together can also be blasted in this way. In order to dig a ditch satisfactorily, it is always necessary to explode a number of charges simultaneously. In dry soils this can be done only by electric blasting. In well sinking and other kinds of blasting it is of advantage to explode a number of charges at one time, as each tends to help the other. The only way in which several charges some distance apart can be exploded at exactly the same time is by the electric method of blasting. Electric blasting may be applied to all of the work described in this Handbook, but it is generally unnecessary and more expensive, except in the blasting just described.

The equipment for blasting by electricity, in addition to the explosive, consists of

Electric Blasting Caps
Connecting Wire
Leading Wire
Blasting Machine

When the charges have been primed with electric blasting caps and tamped, the two copper wires protrude from the ground over each charge. These two wires should be separated and one of them connected to one of the wires of the next electric blasting cap on one side and the other one should be connected in the same way to one of the wires of the electric blasting caps in the hole on the other side. This should be continued until all of the charges are connected in a row with one free wire extending from the first charge and another extending from the last charge. These loose wires are connected to the wires leading to the blasting machine. This is called "connecting in series." If the holes are too far apart for the electric blasting cap wires to reach between them, pieces of connecting wire are used.



Method of Connecting Wires for Electric Blast

Connections are all made by twisting bare wire ends securely together. All wire ends should be scraped with a knife so that they will be free from grease or corrosion when connections are made.

All bare joints or other uncovered places in the wires must be kept away from water or damp ground. This can be accomplished by putting a stick, block of wood, or stone under the wire to hold it off of the damp ground.

Blasting Stumps

The root systems of the different forest trees are subject to a considerable number of variations, due to the class of tree, the soil and the depth to sheet water. Ordinarily, forest trees are divided according to their root systems into three classes. These are: Those having tap roots; those having no tap roots, but only lateral fibrous roots; and those having both a small tap root and many fibrous roots. When trees that normally develop heavy tap roots are grown on soils where the ground water level is very near the surface, the tap root will be materially shortened or entirely wanting. Fibrous rooted trees growing in loose soils not troubled by bad drainage, may send heavy lateral roots to considerable depths. The highly resinous tap roots of such trees as the pine decay very slowly.

Several factors very materially influence the blasting of stumps, notable of which are:

The character of the root, whether tap or fibrous.

The nature of the soil with regard to the resistance it offers the explosive.

The moisture content of the soil.

The state of preservation of the stump, whether sound or partially decayed.

Freshly cut or green stumps are much harder to blast than those from which the small fibrous roots and bark have decayed.

Success in stump blasting is a matter of common sense and discretion, and may be undertaken by anyone of reasonable intelligence, who will follow out carefully the rules laid down on the following pages.

Blasting Tap-Rooted Stumps

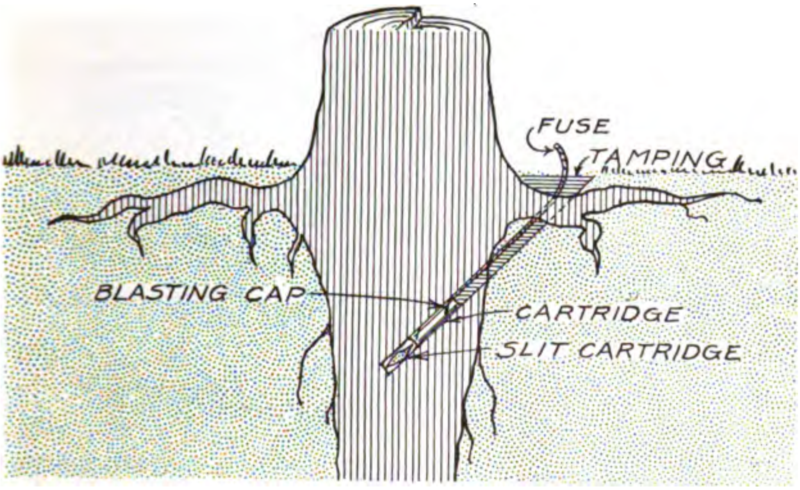
There are two distinct methods of blasting tap-rooted stumps. The charge can all be placed in a single hole bored into the root, or it can be placed in one, two or three holes alongside the tap root. When two or more holes are used, electric firing must be practiced. Each method has its advantages. Placing the charge in the stump requires more labor and a smaller charge, while the other method requires but little labor and a greater amount of explosives. The first method reduces the stump and tap roots to smaller fragments, and is generally used by those blasting stumps for distillation.

Loading in the Tap Root

In placing the charge in the root a spade is used to remove a little soil so that the tap root is exposed to a depth of a foot or more. The hole is bored diagonally downward through the center of the root, using a heavy 1½ or 2-inch wood auger. This should reach well below any possible depth of subsequent tillage, and more than half way through the root.

In loading it is best to use a half-cartridge primer and remove the rest of the charge from the paper shell. Pack the charge firmly in the bottom of the hole and press the primer firmly against it. The hole should then be tamped tight up to the very collar. Better results will be obtained if the soil is pushed back into the hole made to expose the tap root.

The charge will vary from a half-cartridge primer for small roots to three or four cartridges for very large solid stumps. Stumps having decayed or hollow tap roots should not be loaded in this way, as they can be gotten out better by two or more charges placed around the tap root.



LOADING TAP-ROOTED STUMP, USING CAP AND FUSE

When electric boring machines are used it will not be necessary to use a shovel, as the hole is started in the root immediately at the surface of the soil, and can range almost straight down into the tap root.

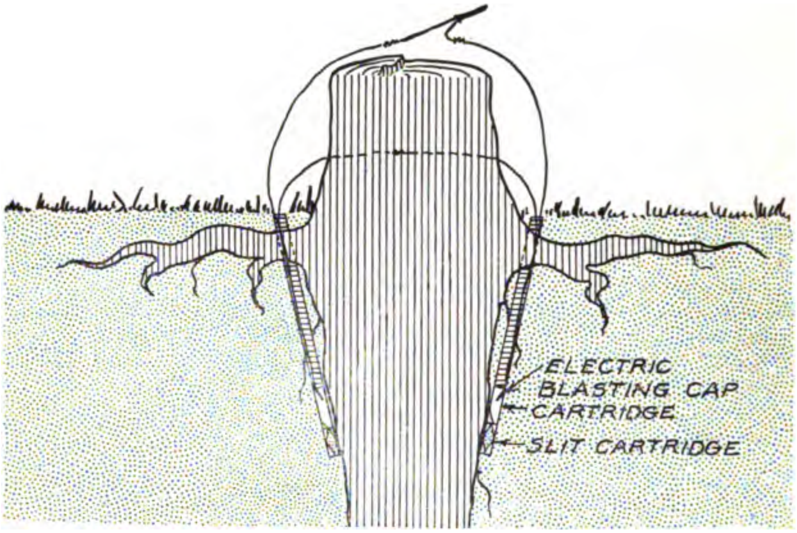
The best explosive for this class of work is Red Cross Stumping Powder. Red Cross Farm Powder will give good results on small stumps, but will require slightly heavier loading.

Loading Around the Tap Root

When placing the charge between the tap root and the subsoil, the wood auger will not be needed, as the holes can be made faster with a soil auger or crowbar.

In this method much depends on the depth and location of the bore holes, which should be not less than three feet deep, and usually more. The charge should be snug up against the tap root, so that it will lie immediately alongside the wood.

When but one hole is used for blasting small or old stumps, the charge should seldom be less than 1½ cartridges. If the holes are dry all the charge except the half-cartridge primer should be removed from the shell and packed tightly in the bottom of the hole. The tamping must be tight. Such a charge can be fired with cap and fuse. In clay and clay loam subsoils Red Cross Stumping Powder should be selected, but in light or sandy subsoils Red Cross, or Du Pont Straight Dynamite 50 or 60 per cent. will give better results.



LOADING TAP-ROOTED STUMP FOR ELECTRIC BLAST

When two or more charges are distributed around the tap root, the same care should be exercised in putting down the holes, and if the stumps are large the holes should be not less than four feet deep. Only electric caps can be used. The charges will vary from 1½ to 2½ cartridges for each hole.

Blasting Semi-Taprooted Stumps

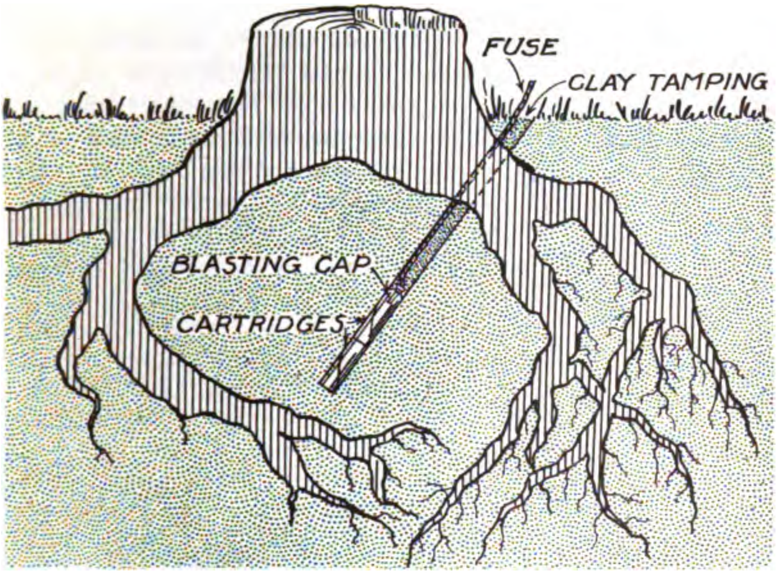
Where stumps have a tap root of medium size and a heavy set of lateral roots, the loading will be intermediate between the loading for tap-rooted and lateral-rooted stumps. When they are of any considerable size, better and cheaper results will be obtained with distributed charges and electric blasting.

Blasting Small Fibrous-Rooted Stumps

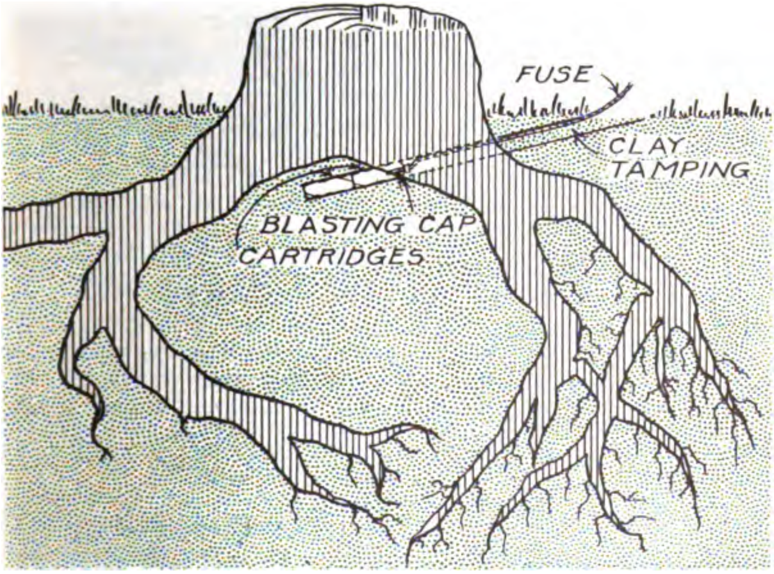
When stumps have no tap root, but only fibrous ones, the loading will depend on the nature of the soil and the size and state of preservation of the roots. When they are small or the roots are partly decayed the charge can all be placed in a single hole started a little way back from the stump and sloped under the part of the stump that will be hardest to lift. The charge will run all the way from less than a cartridge to several cartridges.

Where the subsoils are tight and offer good resistance Red Cross Stumping Powder will prove itself to be the most satisfactory and economical explosive. In loose sandy soils 40, 50 or 60 per cent. Du Pont Straight Dynamite will be better.

Here, again, the depth of the holes will play an important part. If they are too shallow the blast will only split the stump and fold the parts back without blowing them out. It is seldom that the loading should be as shallow as 30 inches and, if the stumps are at all hard to blast, 4 or more feet is better.



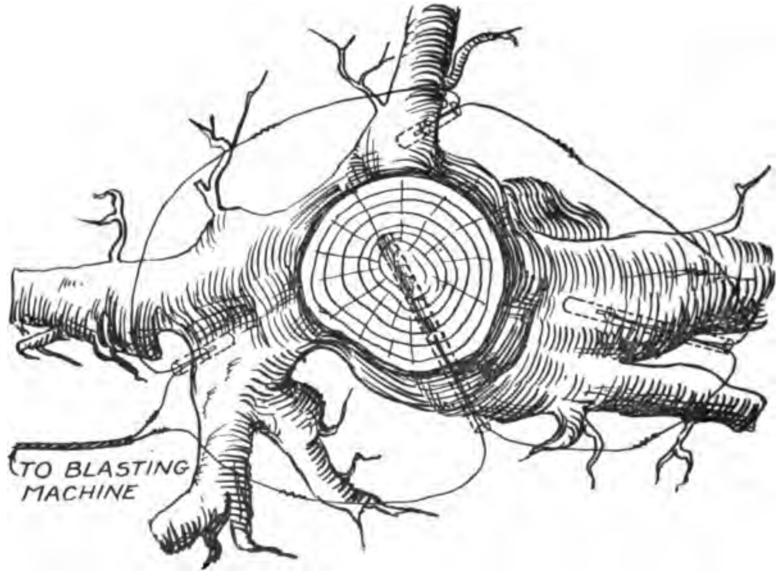
CORRECT METHOD OF LOADING SMALL STUMP—KEEP CHARGE WELL DOWN



INCORRECT METHOD OF LOADING SMALL STUMP—CHARGE TOO SHALLOW TO LIFT STUMP, BUT WILL BE FOUND IDEAL FOR SPLITTING THEM WHEN USING A STUMP PULLER

Blasting Large Fibrous-Rooted Stumps

The use of electric blasting is essential in blasting large stumps or those having wide-spreading roots. If the charge is confined in a single bore hole the effect will be to split and not lift the stump, but if the same or a smaller charge is distributed in several well-located holes, the blast will lift the stump perfectly. The number and location of the holes must be governed absolutely by the individual stump. For stumps slightly larger than can be lifted by a single charge, two holes will usually be sufficient. These should be on opposite sides of the stump, and should be inclined under the stump. For larger stumps three or more holes should be used. One of these should be under the center of the stump and the rest so placed around the outer edge as to form a circle under and around the holding roots, as is shown below.



METHOD OF LOADING LARGE STUMP FOR ELECTRIC BLAST

As in all stump blasting, the holes should be well down into the subsoil—not close up to or in contact with the wood.

The best explosive for this work is Stumping Powder, unless the subsoil is loose and open, when 40 or 50 per cent. Red Cross Dynamite will be found more satisfactory.

Blasting Stumps From Very Soft Soil

For cypress, willow or other stumps in very soft, swampy soil, modification must be made in the methods of loading on account of the poor resistance offered by the soil and the enormous number of spreading roots. The holes must be so distributed so that not only the stump, but all of the main-spreading roots will be blown out down below plowing depth. The quick-acting Du Pont Straight Dynamite of 50 or 60 per cent. strength gives best results in warm weather.

Many of the cypress stumps are found to be only shells, the heart having been entirely rotted away. To blast these successfully drive a post into the soil through the hollow, and tamp the stump full of moist soil, remove the stake and load in the hole left by the post and tamp solid.

Approximate Charges for Blasting Stumps

No absolute rule can be laid down giving the required charge for blasting stumps of different sizes, but the following, which is based on old but solid stumps in firm, dense soil can be used as a basis, making variations either way as may be required:

Diameter of stump in inches..........	12	18	24	30	36	42	48
Number of cartridges of Red Cross Stumping Powder	2	3	4	5	7	9	11

If the stumps are green, or if the soil is loose or sandy, these amounts must be increased, but if the stumps are partly decayed, lighter loading will do the required work.

Felling Trees

The loading for blasting down standing trees is the same as for stumping, with the important difference that heavier loading is required, because of the greater weight to be lifted. If this work can be done during a high wind, the wind load on the tops of the trees will materially assist in bringing them down.

Combining Blasting With Other Methods of Stumping

While the use of explosives for stumping has been found to be a great money-saver in clearing land, there are some classes of stumps that can be more cheaply disposed of by combining the use of explosives with a good steam, horse, or hand puller. This is particularly true on large areas of large fibrous-rooted stumps. The operation consists of loading the stumps with comparatively small charges and splitting them into several sections. This loosens the soil from the roots and allows them to be easily pulled out clean and ready to burn. The holes left are small and quickly filled.

Filling Holes After Stump Blasting

The small holes left after stump blasting can be quickly filled with a small horse scraper. Start at one side of the field, scraping up a little soil on the way to be dumped in the first hole. Do not turn when the load is dumped, but go straight to the next hole and dump the new load, and so on, until the entire field is crossed.

Splitting Stumps for Burning

When the wood is not needed for distillation or fuel, fat pine stumps can be economically disposed of by shattering the tap root at a depth of about two feet with a small charge of dynamite and then burning. Several days should be allowed for drying after the blasts are made. A little labor to keep the fires punched up will insure good work.

Splitting Old Logs and Stumps

In disposing of old grubbed or pulled stumps or large logs much time can be saved by boring holes in the wood and loading with a small amount of any explosive that is being used on the job. The depth of hole and size of charge will be governed by the size of the log or stump to be split. Good tamping is essential.

Disposal of Stump Fragments

The shattered fragments of blasted stumps can be disposed of in a number of ways, depending on the local conditions and the character of the wood. The fat pine stumps are in an excellent condition for distillation and require little chopping to fit them for the retorts.

Where wood is scarce and fuel high the fragments are often used for stoves or grates. This is especially true of the pine stumps.

Where there is an excess of wood and the roots are not wanted for distillation they are in a good shape to pile in the field and burn. The ashes left from burning stumps are rich in potash and lime, and have a very beneficial effect on the soil.

Stump fragments are also very useful for filling old gullies, as they can be piled into the bottoms of the old washes, where they will form a good substitute for blind ditches after they have been covered over with soil.

West Coast Conditions

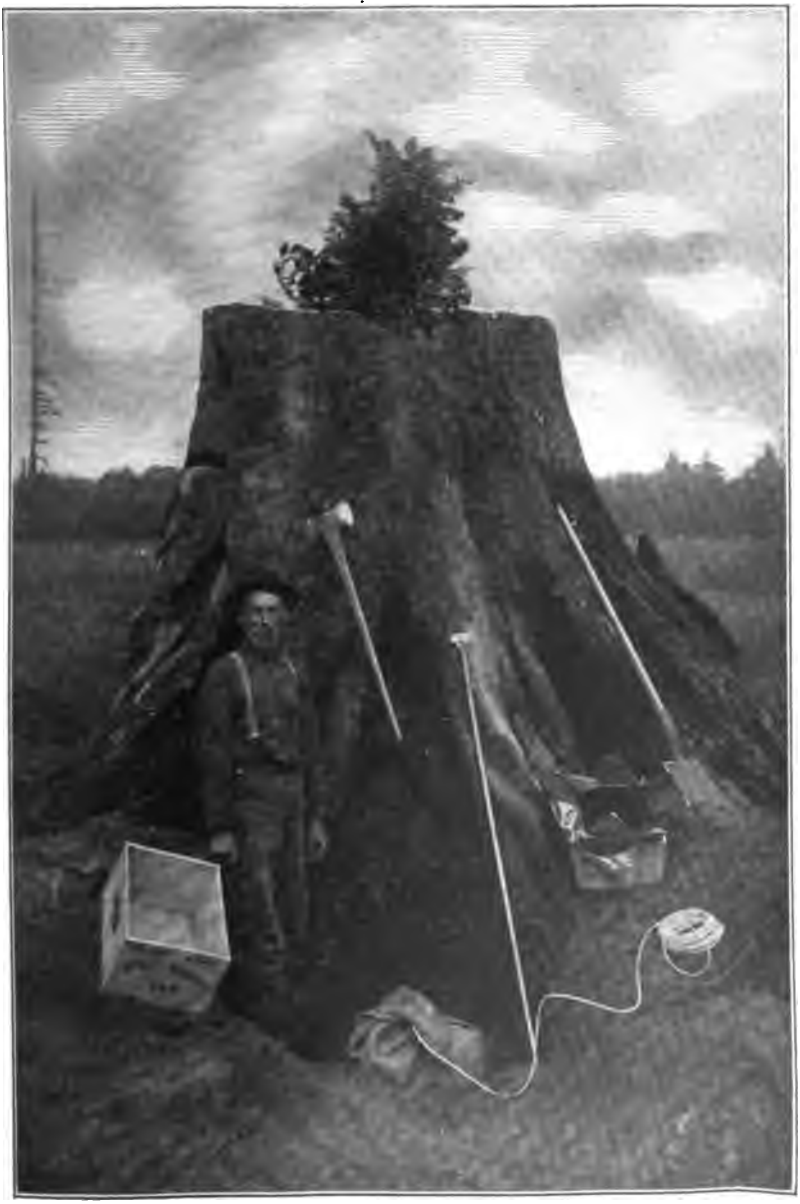
Western Fir, Pine and Cedar Stumps

In the States of Washington, Oregon and parts of California, where the rainfall is large and the ground in the forests is always damp, many of the trees grow to great size—some being eight or ten feet in diameter. The roots of these trees usually spread out near the surface and do not grow deep into the ground as might be expected, tap roots being extremely rare.

The object when blasting these stumps is not to split them, but to bring them out entire at one blast, with all of the roots possible, because if the charge of explosives is so gauged and located as to split the stump, it generally fails to bring out all of the pieces. As the principal object is to get out as much of the stump as possible at a minimum cost, it is better to blast it out first and then it can be easily split afterwards by means of a small quantity of dynamite exploded in auger holes.

The common rule in blasting these stumps is to use one and one-half pounds of Du Pont or Repauno Stumping Powder per foot of diameter, with stumps up to four feet, when the subsoil is clay. For larger sizes from two to two and one-half pounds for each foot in diameter should be used. Stumps in gravelly or loose ground require one pound more for each foot in diameter.

The charge of explosives is best placed so that there will be from sixteen to twenty-four inches of earth between it and the bottom of



LOADING A BIG TREE STUMP

the stump. This results in the force of the explosion radiating to all sides, lifting the stump clear of the ground, and bringing with it the greatest length of roots. If the charge is placed too close to the stump, the effect is to split it, leaving the roots to be dug out at extra labor and expense.

When these stumps are large the bottom of the bore hole is "sprung" or chambered until it is so large that the increased charge required can be concentrated under the center of the stump. The chambering is done by exploding without tamping, first a half cartridge, then several successive charges of from one to five cartridges each in the bottom of the bore hole. When the hole is large enough it is given time to cool off and is then charged with the necessary quantity of Du Pont or Repauno Stumping Powder to bring out the stump. *Under no consideration should the hole be charged until it has had time to cool off.*

The best plan is to work on other stumps awhile to give the chamber time to cool.

See pages 137 to 149 for proper methods of priming, charging, tamping and firing.

Redwood and Bigtree Stumps

The way to estimate the quantity of Du Pont or Repauno Stumping Powder necessary to blast out stumps larger than eight feet in diameter, is to square the largest diameter in feet, the result being approximately the number of pounds required. For example, if a stump is eight feet in diameter the charge of Du Pont or Repauno Stumping Powder should be about the square of eight, or sixty-four pounds. Stumps less than eight feet in diameter require a little greater charge for their size than do the larger stumps, and the rule with them is to use as many pounds of Du Pont or Repauno Stumping Powder as eight times the largest diameter in feet. On this basis a stump six feet in diameter would need about forty-eight pounds of powder. However, the successful blasting of these large stumps depends greatly on the judgment of the blaster, and these rules can only be considered as a general guide. This can easily be understood when it is remembered that, owing to difference in soil or some peculiarity in the growth of the tree, it sometimes requires the same quantity of explosives to properly bring out a stump six feet in diameter as it does another one eight feet in diameter.

In blasting these stumps a trench is dug large enough to permit placing the entire charge of explosives directly underneath the center of the stump. A little powder blasted in holes punched with a crowbar will prove of great assistance in digging this trench.

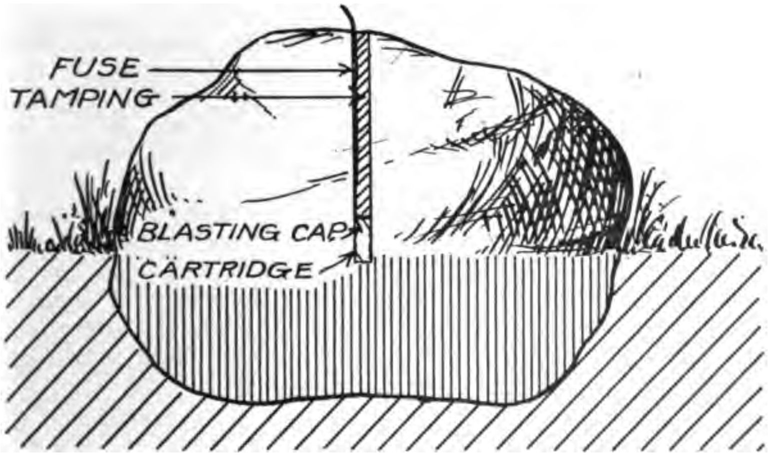
The charge should be firmly tamped. Avoid being on the same side of the stump as the trench when the blast is fired, as fragments, etc., are thrown with more violence and to greater distances on that side.

Boulder Blasting

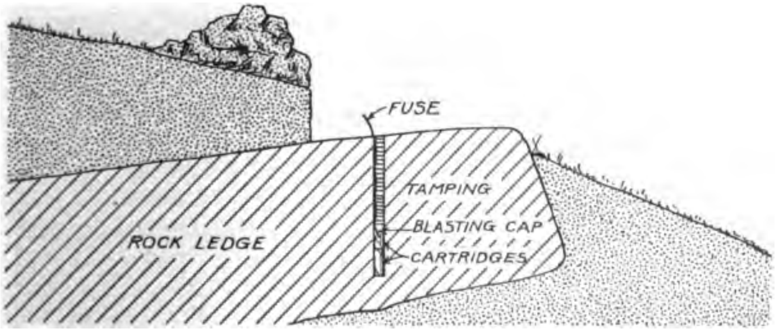
There are three distinct methods of loading for breaking field boulders. These are: "Blockholing," "Snakeholing" and "Mudcapping." Blockholing requires the smallest amount of explosives, but the most labor; while mudcapping requires the smallest amount of labor, but a considerably larger amount of explosives; snakeholing is intermediate in both labor and amount of explosives required.

Blockholing

Blockholing consists of drilling a hole into the boulder and charging it with a small amount of dynamite. It is the best method for breaking very hard or very large boulders, especially those of



PROPERLY PLACED BLOCK HOLE CHARGE



CORRECT METHOD OF LOADING THE OUT-CROP OF A ROCK LEDGE the "nigger-head" type that are so difficult to break by other methods. The hole should usually be drilled about half way through the boulder and may be an inch or larger in diameter.

The explosive should be removed from the shell and packed firmly into the bottom of the hole. When the entire charge is in, make a hole for the cap in the top of the powder with a pointed hardwood stick. Press the cap into the hole and tamp it in with moist soil. The hole should be tamped full.

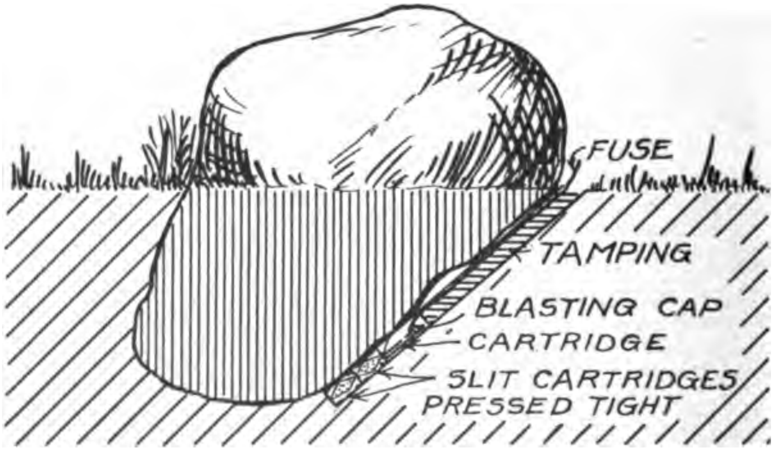
As the confinement is perfect in such loading any of the Du Pont high explosives recommended in this book will give good results. Red Cross Stumping Powder is especially recommended.

Blockholing is very effective in blasting out-cropping ledges that are too large to remove entirely.

Snakeholing

Snakeholing consists of punching a hole under, but immediately against the bottom of a boulder and placing the charge of explosives in as compact a shape as the size of the hole will permit. A better idea of the method can be had by glancing at the figure. The explosive being confined on the underside by the earth, can exert a powerful blow on the boulder and will roll it out or if a sufficient charge is used will break it in fragments.

This is one of the easiest and most successful methods of boulder blasting. The best explosives for this work are either Red Cross Stumping Powder or Red Cross Extra 40 per cent. Dynamite. Electric blasting is not generally used unless the boulders are very large and more than one charge is used to blow them out. Many blasters prefer to lift boulders out with a snakehole shot and later break them with a mudcap.



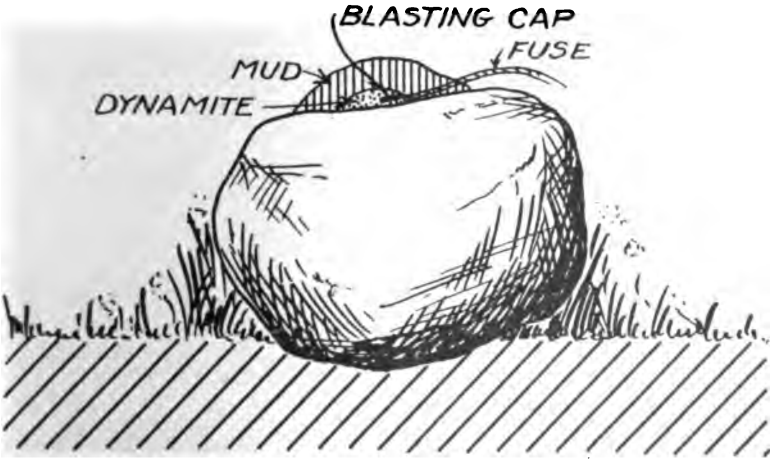
PROPER METHOD OF PLACING AND LOADING A BOULDER FOR SNAKEHOLE SHOT

Mudcapping

Mudcapping is known by a variety of fantastic and expressive names, such as "Bulldozing," "Blistering," "Poulticing" and "Adobe Shooting," and is made possible by the fast, shattering action of the higher grades of dynamite. In practice it consists of removing the dynamite from the shell and packing it in a compact conical heap on the boulder, and after inserting a cap and fuse covering it with several inches of thick, heavy mud.

The explosive should be placed on the boulder at the place where it would be struck with a hammer were it small enough to break in that way. This may be on the top or side. If the boulder is embedded in the ground, a snakehole shot to roll it out on the surface should first be made, because the confining dirt makes it much harder to break with a mudcap shot. The mud covering should be as thick and heavy as it is convenient to make it, not less than 5 or 6 inches, and should be free from stones, as the blast will throw them as though they were bullets. Never lay a stone on top of the mud for the same reason.

The explosives used are Red Cross Extra 40 per cent. for easily broken rock, and Du Pont Straight 50 per cent. for hard niggerhead boulders.



CORRECTLY PLACED MUDCAP. THE MUD COVERING SHOULD BE SEVERAL INCHES THICK

Combining Mudcapping With Snakeholing for Large Boulders

For very large loose boulders, where it is not practical to drill, it is often well to combine these two methods of loading, using one or more charges in snakeholes and a big mudcap. The explosions on two sides at the same time intensifies the shock to the boulder to such a point that it will break when either method of loading alone would be ineffectual. Such charges must be fired electrically.

Disposal of Boulder Fragments

Many uses can be made of boulder fragments after the blasting is done. The accompanying cut shows a beautiful home built of fragments of field stones by a progressive blaster who was clearing up a large field. Other uses are for building foundations, walls, fences, roads, for making concrete, or for various other uses about the farm.

They are also very useful for filling gullies or discarded ditches, and, as they do not lie close together, will form blind drains to remove excesses of rain water.

Where large boulders leave deep holes much of the debris can be buried in the bottom of the holes, but care must be taken to keep it well below plow depth.

HOUSE BUILT OF FRAGMENTS OF BOULDERS BLASTED FROM ADJOINING FIELD

Amount of Explosives Required for Blasting Boulders

On account of the differences in hardness of rock in different places, and the variations in shape in a single field, it is impossible to give exact information as to the amount of explosive to use. The following table, which is based on stone of average hardness loaded with Du Pont Straight 50 per cent. Dynamite, will give some idea of the amounts to use in making test shots. It will be necessary to vary these for local conditions:

Amount of Dynamite Required to Break Boulders

Diameter of Boulder in Feet	Number of Cartridges Required		
	Mudcapping	Snakeholing	Blockholing
1½	2	1	¼
2	3	1	¼
3	4	1½	½
4	Don't attempt	4	¾
5	Don't attempt	6	1

This is based on the use of Du Pont Straight Dynamite of 50 per cent. strength. If Red Cross Extra 40 per cent. Dynamite is used increase the amounts by half, and if Du Pont Farm Powder is used for snakeholing or blockholing, double the amounts.

Explosives for Boulder Blasting

For boulder and other rock blasting, the recommendations in this book can be followed literally, because the grades of dynamite recommended can be obtained in West Coast States.

SUCCESSFUL BOULDER BLASTING IN SWEDEN, SHOWING A WELL-LOCATED MUDCAP

Ditching

There are two distinct methods of blasting ditches; the propagated and electric. The propagated method can be used only in wet soils, while the electric method can be used in either wet or dry soils. The explosives and blasting supplies needed and the methods of loading vary considerably in the two methods.

Among the most striking advantages of ditching with dynamite, as compared to other methods, is the reduction in cost, the absence of a large soil pile along the ditch, the little time required, the absence of overhead expenses for equipment, the ability to dig successfully where the conditions are too bad for other methods, the adaptability to both large and small ditches, and the simplicity of the methods. These have been pointed out in the introductory section accompanying this booklet.

Ditching in Saturated Soils Without a Blasting Machine

In wet soils, where holes two feet deep will stand half full of water, the quickest and generally the most economical method of ditching is with Du Pont Straight 50 per cent. dynamite. *Only a straight dynamite can be used for this work, as other grades are too insensitive to be detonated by the shock from a single primer in a central hole.* This can be practiced in the roughest of swamps, even where there are several inches of water standing on the surface or where the surface is covered with the heaviest of swamp stumps.

This class of ditch blasting should not be attempted when either the air or water is colder than 50 degrees F.

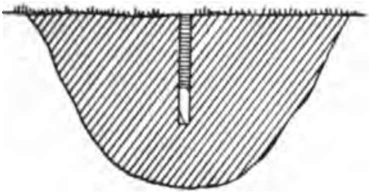
The simplicity of the method and the truly wonderful results obtained must be seen to be fully realized.

The course of the ditch having been decided on by a survey or close study of the slope, as indicated by the surface drainage and the trees having been chopped from the right of way, the work may be begun.

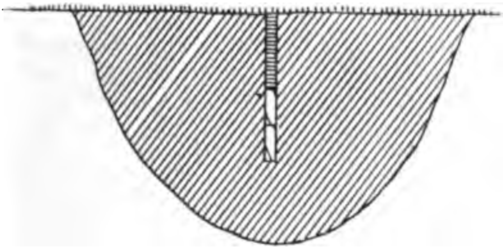
Test Shots

The first thing to do is to try a few trial shots to ascertain the best depth and spacing for the holes. For ditches up to 3 or 3½ feet deep the depth of bore holes will usually be about 24 to 30 inches, and the spacing between holes from 18 to 24 inches, although it may be necessary to increase the depth and decrease the spacing in some cases. It is well to begin the test with holes two feet deep and 18 inches apart. Keep these in line and load about 10 of them with one cartridge each. If a little water covers the cartridges in the holes no further tamping will be needed. If not, tamp well with earth. After the entire line is loaded, one hole is charged with an extra primer cartridge, and it is also well to put one additional in each hole adjoining the primer.

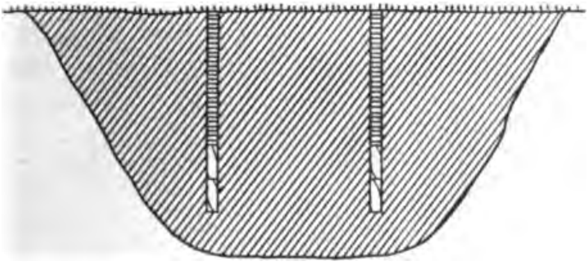
This loading should lift the soil at least two hundred feet into the air, scatter it over the adjoining swamp for a distance of 150



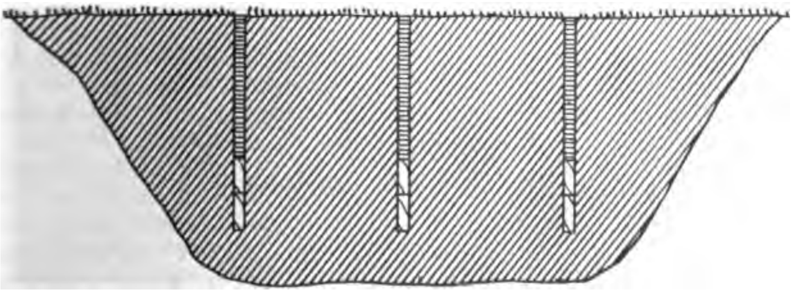
A SMALL CHARGE AND A SMALL DITCH



A HEAVIER CHARGE FOR A LARGE DITCH



TWO ROWS OF CHARGES WILL EXCAVATE A WIDER DITCH THAN IS POSSIBLE WITH A SINGLE ROW



BY USING THREE ROWS OF CHARGES MUCH LARGER DITCHES MAY BE DUG feet and leave a good, clean ditch. If it does not, try a different loading. It may be necessary to make the holes deeper in some soils and not so deep in others. Usually in swamp soils the ditch made is a foot to two feet deeper than the charge, but sometimes it is necessary to load to the full depth.

If the test shot makes too large a ditch, the spacing can be increased a little, but should seldom be greater than 24 inches, and then only in warm soil. For very small ditches less than a full cartridge of explosive may be used in each hole.

Amount of Charge and Size of Ditch

Small ditches (for instance, about two feet deep and three feet wide) in such soils, when there is little trouble from roots, can be dug with half cartridge charges, but when using such small loads the spacing between holes can seldom be over 18 or 20 inches.

Larger ditches can be dug by using two or more cartridges in each hole, and a second, or even a third line of holes may be put down about four to five feet from the original line and loaded in the same way. When two or three lines of holes are used it will be necessary to use one electric cap in each line, or to put in one or two extra charges between the rows to insure the simultaneous detonation of all the charges.

Approximate Table of Charges of Du Pont Straight 50% Dynamite for Blasting Ditch Without a Blasting Machine

Top Width of Ditch	Approximate Number of Cartridges Per Hole Required for Ditches of Various Depths				Number of Parallel Rows Required	Distance Between Rows in Inches
	2½ to 3 ft.	4 ft.	5 ft.	6 ft.		
6	1	2	3	5	1	. .
8	1	2	3	5	1 or 2	30
10	1	2	3	5	2	36
12	1	2	3	5	2	42
14	1	2	3	5	2	48
16	1	2	3	5	3	36
18	1	2	3	5	3	42

Distance between holes in rows 16 to 24 inches to be determined by 3 or 4 test shots. It is impossible to specify exactly, because soil conditions differ greatly, which makes a difference in spacings and loads.

Putting Down the Holes

Ordinarily in swamp soils the bore holes can be put down with little effort. If the soil is at all hard, or has a heavy crust, the fastest tool is a good sharp crowbar, but if soft and mucky, a heavy tamping stick will suffice. The holes should not be left open, but should be loaded at once, as they will cave in or be filled with floating slime.

Amount of Dynamite Required for a Given Length of Ditch

In order to enable the blaster to calculate the amount of dynamite required to cut various size ditches, the following table used in conjunction with either of the preceding tables should prove very useful:

Spacing between holes in row	10 Rods			¼ Mile			½ Mile		
	Number of holes	Dynamite required using charges per hole of		Number of holes	Dynamite required using charges per hole of		Number of holes	Dynamite required using charges per hole of	
		½ cartridge	Whole cartridge		½ cartridge	Whole cartridge		½ cartridge	Whole cartridge
18 ins.	110	28 lbs.	55 lbs.	880	220 lbs.	440 lbs.	1760	440 lbs.	880 lbs.
20 "	99	25 "	49 "	792	198 "	396 "	1584	396 "	792 "
24 "	83	21 "	41 "	664	166 "	332 "	1328	332 "	664 "
26 "	76	19 "	38 "	608	152 "	304 "	1216	304 "	608 "
28 "	71	18 "	36 "	566	142 "	284 "	1132	283 "	566 "

1 rod — 16½ feet.
10 rods— 165 feet or 55 yards.
¼ mile—1320 feet or 440 yards or 80 rods.
½ mile—2640 feet or 880 yards or 160 rods.

For larger ditches requiring heavier loading or several parallel rows of holes increase the total amounts accordingly. These amounts also apply to ditching with a blasting machine.

Ditching With a Blasting Machine

While it is possible to blast ditches by the propagated method, that is, without blasting machine, only in wet soils the electric method can be employed in any class of material, dry sand excepted, and low strengths of low-freezing Red Cross can be substituted for the more sensitive straight dynamite.

The layout of the ditch is exactly the same as for the other method, but as an electric cap is used in each hole it is possible to space them farther apart in the row. The normal distances are from 24 to 32 inches for small ditches, and up to 48 and 52 inches for large ditches.

Different Explosives for Different Classes of Work

The explosive selected for electric ditch blasting will depend upon the soil and size of ditch. In a medium loam, where only a small ditch (for instance, two feet deep and three feet wide) is desired, the selection may be Red Cross Stumping Powder, Red Cross Extra 30 or 40 per cent. Where the material is very sandy Du Pont Gelatin 40 per cent. will give best results. It is practically impossible to blast ditches in dry sand.

For larger ditches, or where there is much trouble with stumps and roots, a stronger explosive will give more economical excavation, and Red Cross Extra 40 per cent. or Du Pont Gelatin 40 per cent. should be selected. Where the work is very wet, and the charges must be left in the water for a long time, the gelatin should be selected, as it is more water-resisting than the Red Cross.

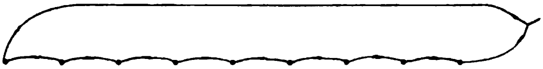
Methods of Loading

After 3 or 4 trial shots similar to those described for wet ditching have established the proper depth and spacing of the holes, and the amount of dynamite per hole, the blaster is ready to begin actual operations. The holes may be put down with a subsoil punch, crowbar, soil auger, or any other tool suitable for the particular class of soil.

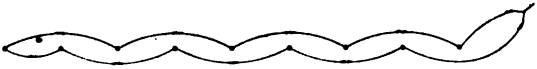
Unless water covers all charges they should be thoroughly tamped. It is best to punch only enough holes for one blast, load them and fire, before putting down more, as they are likely to be filled up or covered with trash thrown up by the blast.' Do not overload the blasting machine. If its rated capacity is thirty charges, do not attempt to fire more than that at a time.

When only one cartridge is used in a hole it must contain the electric cap, and should be pressed well down to the bottom of the hole and tamped so that there is no air space left to reduce the effect of the blast. When several cartridges are used in each hole, the primer should be on top, with the cap pointing downward.

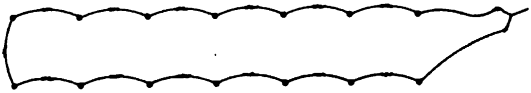
As the work progresses the soil should be carefully watched, and any needed variation made in the loading so that it may always conform to the material to be lifted.



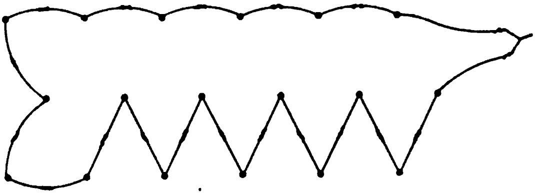
Method of connecting up one line of holes.



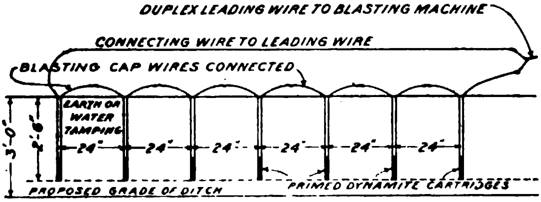
Another method of connecting up one line of holes.



Method of connecting two lines of holes.



Method of connecting three lines of holes.



DUPLEX LEADING WIRE TO BLASTING MACHINE
CONNECTING WIRE TO LEADING WIRE
BLASTING CAP WIRES CONNECTED
EARTH OR WATER TAMPING
3'-0"
2'-6"
24"
24"
24"
24"
24"
24"
PROPOSED GRADE OF DITCH
PRIMED DYNAMITE CARTRIDGES

Showing how the wires are arranged for electric ditch blasting.

METHODS OF CONNECTING WIRES FOR ELECTRIC DITCH BLASTING

Blasting Large Ditches With a Blasting Machine

When larger ditches are desired the loading may be in deeper holes, using more or a higher strength of explosive; or one or two more parallel lines of holes may be employed, especially where wide but shallow ditches are needed. Where very deep ditches are needed, blast a wide, shallow ditch with two or three parallel rows of holes, and then load one or two rows in the bottom of the shallow ditch, and blast another ditch in the bottom of the first one. This latter method has been very efficient in opening large ditches eight or nine feet deep through heavy bottom lands for the correction of stream channels.

Stream Correction

Each spring the big freshets in creeks and rivers are the cause of much property loss. Bottom lands are either washed away or covered with a layer of sand that is too thick to plow under, and the fertility of the soil is greatly reduced.

Permanent control of streams subject to overflow is expensive if undertaken in haste. Equally good results may be obtained with much less expense by undertaking the work in a slower but more systematic way, which will permit the stream to do most of the actual digging itself.

A great part of the filling up of stream courses is caused by logs and other floating material forming rafts and sand bars in the channels. Another fruitful source of trouble is from outcrops of rock which divert or impede the normal flow of the current. Overhanging stumps and trees along the banks lend still further obstruction. Sharp bends in the course of the stream check the current and cause trouble by forming sand bars.

Any and all of these troubles may be overcome quickly and at reasonable cost by the use of dynamite. Shoot out the rafts and logs,

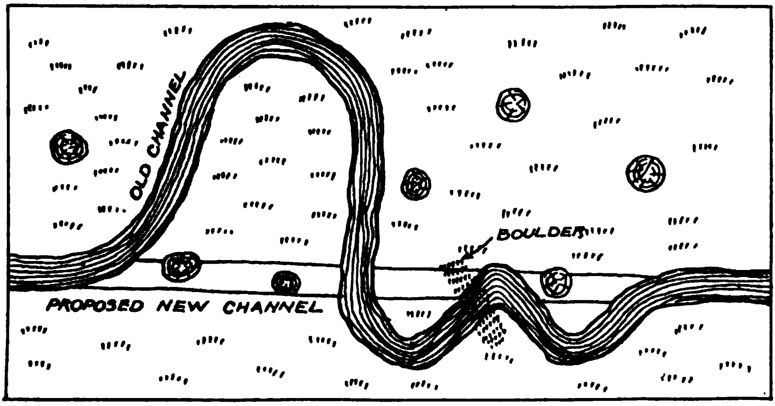


DIAGRAM OF STREAM TROUBLES THAT MAY BE CORRECTED BY BLASTING and blast a sufficient channel through the confining rock. A well-placed blast will cause the overhanging stumps to immediately vacate.

The cutting off of sharp turns in the channel will take a little more time and should be well done in the beginning. Locate the line of the new cut-off and blast a ditch that will at all times carry a part of the flow. When this is done and the rafts and logs are out of the way above and below, all there is left to do is to wait for the heavy rains to flood the streams. The increased rate of flow will cause the water to cut and wear away at the bottom of the channel as well as at the sides. From time to time it will be best to go over the stream and make sure that no new obstruction is being formed.

Small blasted ditches have been scoured out by the current until they are now carrying the entire flow of large streams. With a little help now and then any stream with a fair fall can be made to do wonders in making itself a permanent and suitable course.

Table of Charges for Electric Ditch Blasting

Approximate Top Width of Ditch in Feet	Approximate Number of Cartridges of Red Cross Stumping Powder Required for Various Depths			Number of Rows of Holes Required	Distance Between Rows
	2½ to 3 ft.	4	5 to 6 ft.		
3	1	..	..	1	0 inches
6	2	4	6	1	0 "
8	2	4	6	1 or 2	20 "
10	2	4	6	2	28 "
12	2	4	6	2	36 "
14	2	4	6	2	42 "
16	2	4	6	3	42 "
Required length of No. 6 Du Pont Electric Blasting Cap Wires	4 ft.	6 ft.	6 to 8 ft.		

Although this table is necessarily but an approximation, it will serve as a good basis for estimating ditch charges.

Practice makes perfect in ditch blasting the same as in anything else. The way to get the practice is by blasting short test sections of about ten holes each until the proper loading for the soil condition is determined. After blasting a few ditches, less experimenting in the beginning will be necessary.

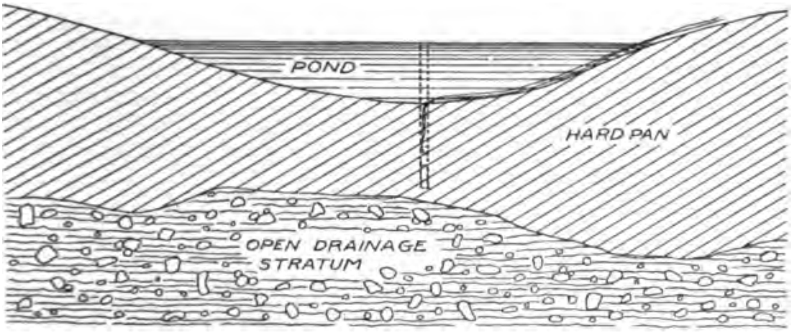
Explosives for Ditching and Drainage

The grades of dynamite recommended in this Handbook for ditching and drainage are sold in all the West Coast States and our instructions, therefore, apply just as given.

Underdrainage of Wet Spots

It is sometimes very difficult to devise a method of draining a depression. Generally speaking, ditching is the proper solution of the problem, but that calls for an outlet and at least some degree of slope.

Ponds and wet spots are caused by impervious soil beneath them. By blasting this impervious stratum, perfect drainage can sometimes be brought about. Certain conditions must prevail, however. First, it must be ascertained by means of a soil auger that there is a stratum of gravel or sand beneath the impervious layer that will carry off the surface water if it is drained down into it.



WHEN PONDS ARE CAUSED BY TIGHT MATERIAL OVER OPEN MATERIAL THEY CAN BE DRAINED BY DEEP BLASTING

The character of the soil type forming the impervious layer must also be noted. If it is shale or a true hardpan that will remain broken up when blasted, the blasting alone, provided it breaks all the way through to the water-carrying stratum of sand or gravel, will prove sufficient to drain the surface.

On the other hand, if the impervious layer consists of a fine sticky clay, it will run together again, if blasted, and the drainage will stop because of the clogging of the outlet. When these conditions prevail, a bore hole should be put down to within about a foot of the underlying stratum of sand or gravel. If this stratum lies over thirty feet below the surface, this method of drainage is impractical. At the bottom of the bore hole a chambering shot should first be made by using a cartridge or two of dynamite. In the chamber thus formed a load of from five to twenty-five pounds of 40 per cent. dynamite (the amount depending upon the depth of the hole) should be placed. Cartridges should also be strung all the way up the bore hole to within about two feet of the top. As the cartridges will all be in contact with one another, one primed cartridge at the top of the line will fire the entire charge. The object is to blast out a well or sink hole. Consequently, the force of the explosives should be exerted upward. Such a shot should form a vertical well from the surface down to the sand. If the soil is of a wet, heavy, clay type, it should not cave much. This well or sink hole should then be filled with cinders, loose stone, stump fragments, or some other material that will prevent the clay from running together again. Such a sink hole should drain the pond or wet spot.

The hole should be put down at the lowest point in the surface; that is, the point to which surface water would naturally run. If the wet spot is a large one covering considerable area, it will probably be necessary to construct several sink holes in the bottom in order to get desired drainage.

In order to determine the depth required, a test hole is bored with a dirt auger, which should be pulled up from time to time in order to clean the hole out, and also to ascertain the nature of the soil encountered, which is readily seen on the spiral thread of the auger. Once the water-absorbing sand or gravel is reached the depth of the hole is noted on the auger shank. This test hole may be tamped full of soil to about 6 inches above the sand or gravel in shallow holes, and 12 to 18 inches in deep holes. This is done because it is not advisable to load the charges in the sand or gravel. They should be located in the hardpan stratum.

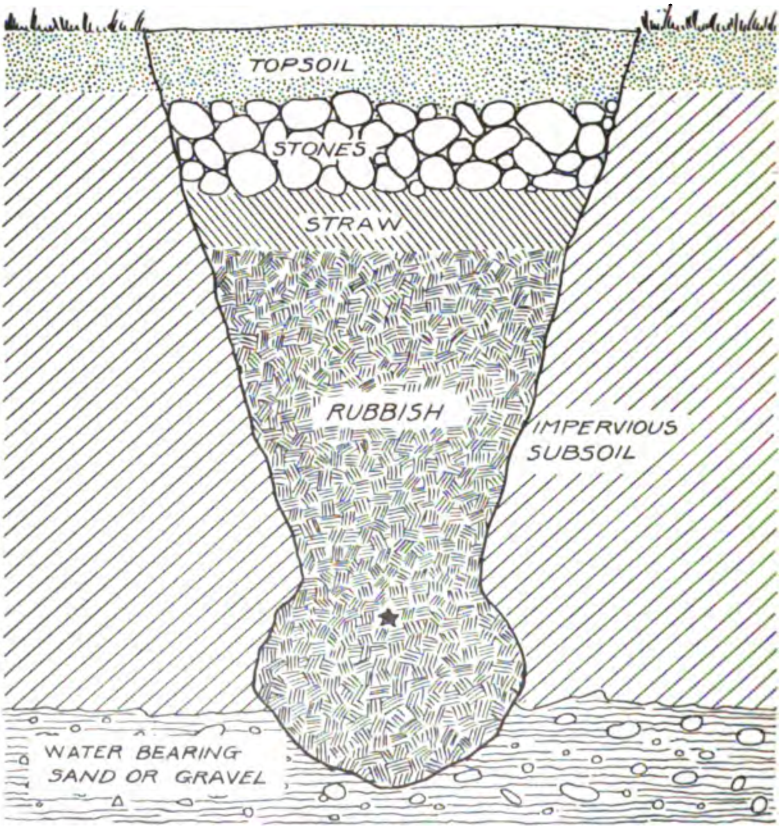


DIAGRAM OF DEEP DRAINAGE HOLE, SHOWING THE USE OF TRASH TO PREVENT THE HOLE BECOMING CLOGGED WITH FINE CLAY

It very often happens that holes have to be bored to depths averaging from 15 to 30 feet before the water-absorbing strata are reached and in order to do this it is necessary to use an extension auger or long churn drill. If the water is too deep to work in, the boring should be done from a raft. It is much easier to operate the auger through a hole in the center of the raft than over the side. As soon as the hole has been bored to the required depth the auger is withdrawn and a piece of 1½-inch pipe sufficiently long to reach the bottom of same and 5 or 6 inches above the water level is inserted. Through this the dynamite cartridges are dropped one at a time and pushed to the bottom with a wooden tamping rod. A good firm push will hold each cartridge in position. The last cartridge but one is primed with a Du Pont Waterproof Electric Blasting Cap and one cartridge is put on top of it to hold same in place, as it is not advisable to give the primed cartridge too hard a push with the tamping rod.

When the hole has been charged the loading pipe is withdrawn and slipped over the ends of the electric fuze wires, the leading wires are connected on to the electric blasting cap wires, the joints being carefully protected with insulating tape and the raft is poled to the shore or a safe distance away from the hole while the leading wire is carefully paid out. The outer ends of the leading wires are then attached to the blasting machine, the operation of which explodes the charge. It is unnecessary to do any tamping in this work if the holes are filled with water. The cartridges should not be slit. The explosive to use is Red Cross Extra Dynamite 40 per cent., or Du Pont Gelatin 40 per cent. The following table gives the approximate charge for holes of different depths:

Depth of Hole	Approximate Number of 1¼" x 8" Cartridges
5 feet	5
10 "	12
15 "	20
20 "	25
30 "	40
40 "	50

Where the ground is swampy or ponds form in the wet season only and dry up later in the year, the blasting should be done in the dry season when a raft will not be required. This blasting should be done just as described above except that it is necessary to tamp the charge thoroughly unless the bore hole fills up with water. In this work it is sometimes of advantage to make a chamber in the bottom of the hole by first exploding a single cartridge in the bottom. This makes it possible to get more of the main charge into the bottom and break the rock or subsoil better. The explosion of the single cartridge may close the hole a little, but it can easily be opened again with the auger or an iron rod. The main charge must never be loaded immediately after chambering, but a half hour or more allowed for the bottom of the borehole to cool off. This plan of chambering the bottom may also be followed when water fills the bore holes.

It should always be remembered that the first and most essential feature of drainage is the control of the rainfall; that is, holding it in the subsoil by proper tillage where it can nourish the crops. If proper attention is paid to this feature better crops will be produced and the need of heavy ditching materially reduced.

Sinking Wells

Wells are often sunk through rock or ground which cannot be dug to advantage without the aid of explosives. When rock is reached and the earth above is properly supported, a circle of four or five drill holes should be started about half-way between the center and the sides of the well and pointed at such an angle that they will come closer together near the center when they are three or four feet deep. These holes should be loaded about half full of Red Cross Extra Dynamite 40 per cent., with damp clay or sand tamping packed firmly above to the top of the hole and then exploded all together from the surface by electricity. This shot will blow out a funnel-shaped opening in the center, and the well can then be made full size with another circle of holes drilled straight down as close to the sides as possible. If the well is large it may be necessary to drill a circle of holes between the inner and outer circle. The above process should be repeated until the well has passed through the rock or has been

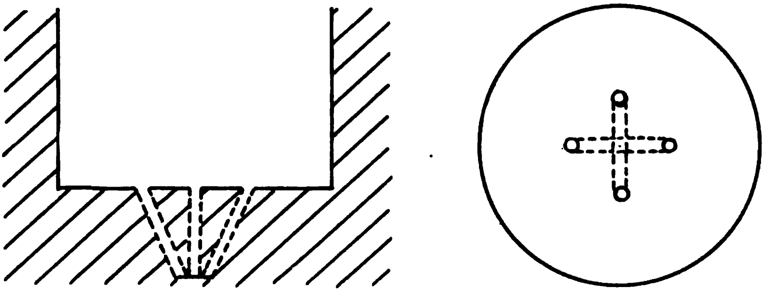
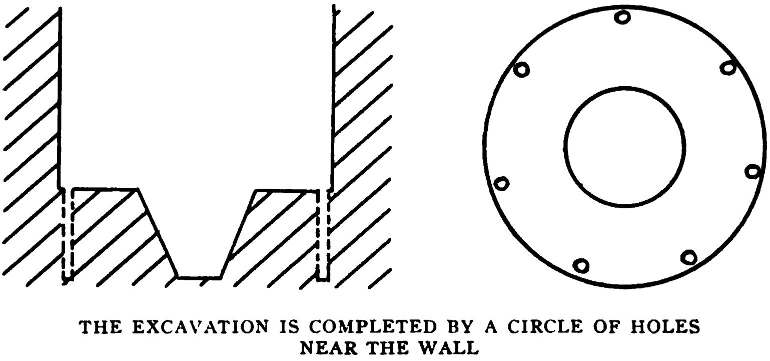


DIAGRAM OF LOADING A CUT SHOT IN A WELL



THE EXCAVATION IS COMPLETED BY A CIRCLE OF HOLES NEAR THE WALL sunk to the necessary depth. Do not in any case enter a well until all the fumes of the last blast have come out. If in doubt, lower a lighted candle to the bottom; if it continues to burn the well may be entered safely. Electric blasting caps will give the best results.

See pages 137 to 148 for proper methods of priming, loading and firing.

Shooting Wells to Increase the Flow of Water

Often drilled or dug wells do not give a sufficient flow, the water being confined in a number of small veins or fissures that do not discharge into the well. The object of shooting a well is to open up these veins or fissures so that all of the confined water is brought together. Where such formations are found successful blasting will usually result in increasing the flow.

Where wells are drilled in dry, non-water-bearing rock, shale, clay or gravel shooting will not produce a flow.

The services of an experienced well shooter should always be secured, and well shooting should never be attempted by the novice in the use of explosives. The Du Pont Powder Company will be glad to correspond with those having work of this kind to do and who cannot get the services of a competent shooter. In writing for information be sure to answer all of the following questions:

For Drilled Wells

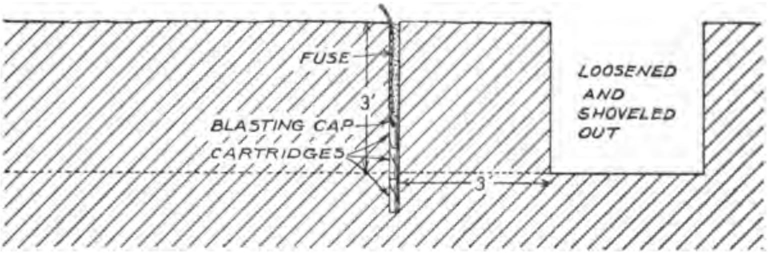
1. Location of well.
2. How many feet is well from nearest buildings?
3. Kind of buildings.
4. Diameter of well in inches.
5. Diameter of casing in inches.
6. Depth of well in feet.
7. Depth of casing in well in feet.
8. How many feet of water in well?
9. Describe the different kinds of soil, rock and other material you went through in drilling the well, and give the location and depth of each class of material.
10. Can the water be partially or entirely exhausted from the well?
11. What is the maximum number of gallons of water the well will furnish in an hour?

For Dug Wells

1. Depth of well.
2. Diameter of well.
3. Type of curbing.
4. Character of rock below the bottom of the well.
5. Has the well always given a poor flow or has the trouble developed recently?
6. Are there any neighboring wells on land as high as yours that are giving a good flow? If so, how deep are they?

Excavating Cellars and Foundations

When it is necessary to make such excavations in rock, the first or "cut" shot should be made with a circle of holes running down to a point as has been described for well shooting. After one small section is down to the required grade the rest of the holes should be drilled straight down. These should be spaced back a distance equal to the depth of the cut and spaced about the same distance apart. When the cut is more than 6 feet deep, the spacing should not be as great as the depth, as more than six feet is hard to blast off.

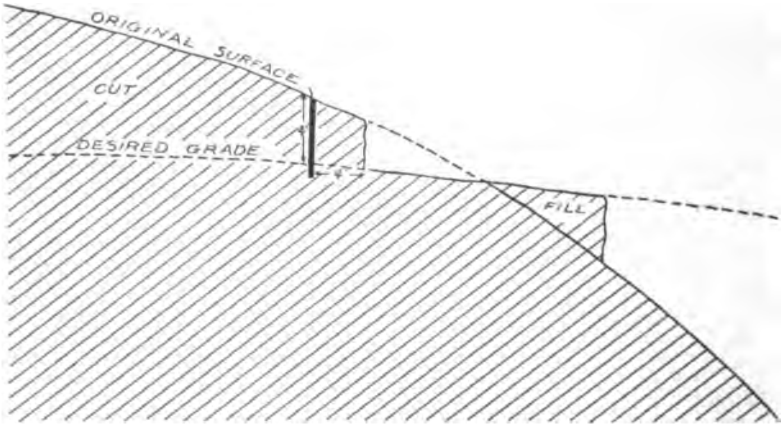


METHOD OF LOADING FOR DIGGING A CELLAR

In reasonably hard rock the drill holes should be loaded a little more than half full of Red Cross Extra 40 per cent., removed from the shells and tamped tight. Better results will be obtained with electric blasting, because then several charges can be fired together, giving a cumulative effect.

In tight clay an opening can be started with a single hole not quite down to grade and loaded with enough dynamite to blow out a conical shaped section of earth. After this is cleaned out, the rest of the holes can be loaded with lighter charges.

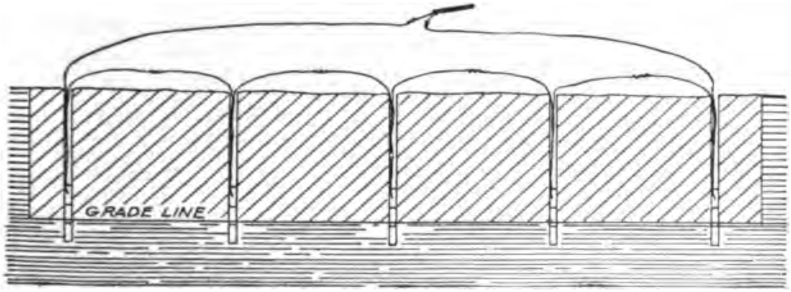
See pages 140 to 144 for correct methods of loading and firing.



METHOD OF LOADING FOR ROAD GRADING OR SIDE HILL CUTTING

Road Building

A rational use of explosives in road building for clearing the right of way, blasting protruding stone from the surface or from the sides of cuts, making cuts through stone or tight clay, digging ditches, reducing grades, widening cuts, and various other purposes, will hasten the completion of the work and reduce the cost.

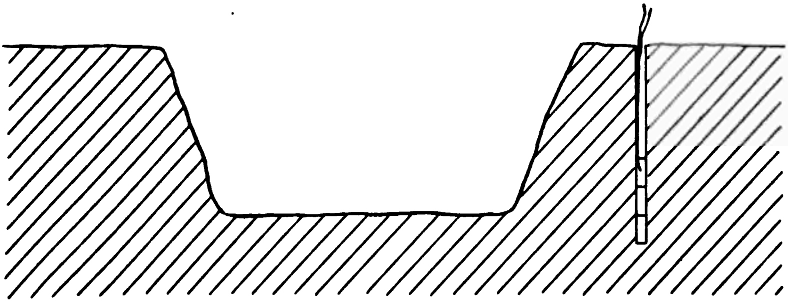


METHOD OF LOADING IN MAKING A CUT THROUGH ROCK OR HARD GROUND

The methods already described for stumping, boulder blasting and ditching, are equally applicable to this class of work. The loosening of tight clays in reducing grades is done in exactly the same way as in digging cellars described under the preceding heading.

In starting in a rock cut the ordinary practice is to drill the holes a few inches below the desired grade. These holes should be spaced back and apart a distance about equal to the depth of the cut, unless the holes are more than six feet deep, when the spacing should be about six feet. Each row of holes should be fired simultaneously with electric caps and a blasting machine.

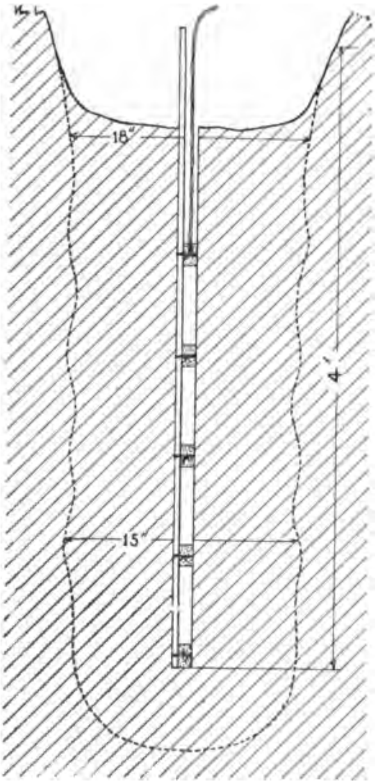
Full directions for priming and loading are given on pages 137 to 140.



LOADING TO WIDEN A CUT

Blasting Telephone Pole Holes a Success

An Investigation and Report by Van Deventer & Warren, Telephone Engineers, Sumter, S. C.



METHOD OF LOADING FOR POLE HOLE BLASTING

Objects.—The objects of this investigation were to develop a practical method of using dynamite for digging pole holes; to ascertain the tools necessary, the cost as compared with hand digging, and the proper quantity and quality of explosive to employ.

Character of Holes.—As little earth should be disturbed as possible. The hole should be of even size from top to bottom, and just large enough to take the pole. The *depth* of hole ranges from 4 feet for 20-foot pole to 7 feet for 50-foot. The *average hole* is 4½-5 feet deep. The poles on telephone lines are set 150 to 175 feet apart. The average is 35 to the mile. The *average diameter* of hole is 14 to 18 inches.

Often with hand digging, there is a tendency to make the holes shallow, owing to the difficulty of working at any depth—even with a post-hole digger. This is particularly true in clay soils or where the hole rapidly fills with water.

The Usual Methods of digging are so well known as to require no description, except to say that the class of labor usually employed is rapidly becoming more difficult to procure. Hole digging is laborious work—nearly every man wishes to become a lineman or do some other kind of work. It is difficult to keep a trained gang of diggers for any length of time.

Average Costs of Usual Methods of Digging.—Costs of this character are difficult to secure, owing to the difference in labor in various sections of the country and the character of the various soils encountered. Many managers think holes can be dug, especially on country lines, for a few cents each, and forget cost of supervision, lost time, etc.

From a large number of records of various companies in all sections of the United States, the following is found to be a conservative estimate of average digging:

Costs for 25-foot poles as commonly used for farm lines is 58 cents each; other sizes will cost in proportion.

Experiments with Du Pont Dynamite.—All holes hereinafter mentioned were wanted 4½ ft. deep. Soils were "Clay and Water," and "Hard Clay," the latter being such that a digging bar would be necessary.

The holes were made with an earth auger.

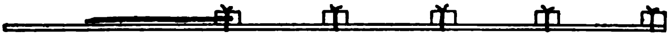
Hole No. 1.—Half stick of Du Pont Straight 60 per cent. in bottom of hole, half Stick Red Cross 40 per cent., 2 ft. from top. Cap in top stick, untamped. Results: Good; hole not sufficiently opened up at top, and earth falls in, filling up.

Hole No. 2.—One-third stick Du Pont Straight 60 per cent. bottom, one-third Du Pont Straight 60 per cent. 8 in. from bottom, half stick Red Cross 40 per cent. 20 in. below surface. Cap in top stick, untamped. Results: Good; hole clean and open.

Hole No. 3.—One-third stick Du Pont Straight 60 per cent. at bottom, same 12 in. up. Same 12 in. up, cap in top stick, untamped. Results: Same as No. 2, except more earth thrown out of hole.

Hole No. 4.—Five quarter sticks Du Pont Straight 60 per cent. evenly distributed about 6 in. apart beginning at bottom hole, untamped, cap at top. Results: Good; hole uniform in size top and bottom, and dirt blown out.

Hole No. 5.—Four quarter sticks Red Cross 40 per cent. distributed same as No. 4. Results: Good; same as No. 4; not quite so much dirt blown out.



DYNAMITE CHARGES TIED TO STICK AND READY TO LOAD FOR A POLE HOLE BLAST

Preparing Holes for Dynamite.—Considerable difficulty was experienced in determining the proper tool to use in making the hole for the dynamite. The ordinary punch bar will not do, except in very light soils. It is unhandy. The auger is a better tool, but too much time is lost in pulling it up to free it in clay. A 4-foot punch bar that can be driven was found to give excellent results if knocked sidewise while driving, so as to enable it to be removed. A hollow crown drill with crossbar, having a cutting head to remove one and three-quarter inches and then bore of two and one-quarter inches gave the best results, enabling a hole four and a half feet deep to be made in about five minutes by one man.

Preparation of Cartridges.—As the dynamite must be distributed, considerable time can be saved by making up cartridges of paper 4 feet 6 inches long, by rolling stiff wrapping paper around a stick of the proper diameter and fastening the pieces of dynamite in same by sticking ordinary pins through the walls of the paper tube.

This properly spaces the pieces of dynamite, and leaves a free space between them, thereby insuring the firing of the lower pieces—the cap always being placed in the top piece. Without the paper tube, there is some danger of the lower pieces not exploding—especially if much loose dirt intervenes. Water does not affect the proper exploding of the lower pieces, but *loose* soil does.

The paper tubes can be stiff enough to push into the hole without crushing. A convenient way of placing the pieces of dynamite is to have a stick with marks 1-2-3-4, etc., on it, and push the pieces into the tube one at a time with this stick and pin them.

FIRING.—There is no necessity for using an electric exploder in connection with this work, but the use of safety matches is suggested. The fuse need only project 2 or 3 inches above the surface, and should be *bent to one side*. The operator may be within fifty feet of the hole, when the dynamite fires, without danger, as there is no general upheaval of earth.

CLEANING OUT HOLES.—An ordinary post-hole digger is desirable for removing the loose earth. No digging bars are necessary, the earth being well broken. The average time for cleaning the hole to receive the pole is 5 to 10 minutes.

COSTS.—Taking the cost of a hole by hand digging at 50 cents, a fair average, then Hole 7 would cost:

	Hole No. 7	Hole No. 8
For Dynamite	$12\frac{1}{16}$ cents	$8\frac{1}{2}$ cents
Fuse and Matches	1 "	1 "
For Labor	14 "	14 "
For Supervision	3 "	3 "
Total Cost	$30\frac{1}{16}$ cents	$26\frac{1}{2}$ cents

NUMBER OF HOLES PER DAY.—The total number of holes per day will be greatly increased when dynamite is used. The labor is much less, and the poles may be more firmly set, as the earth about the hole is packed by the explosion, thereby reducing the amount of tamping necessary when the pole is set. Thus indirectly a considerable saving is effected.

GANG WORK.—Less men are required when dynamite is used. The gang may be made up as follows:

Wagon with tools and dynamite.
Two diggers.
One man with flags and dynamite.
One digger to trim up hole.
One man with fuse and caps.

These are followed by regular pole-raising gang; or go back and set poles after shooting a given stretch of holes.

The long cartridges are preferably made up before the work begins. If necessary supplies of them may be distributed at various points. The usual precautions necessary when handling and transporting explosives should be employed. It is not advisable to cut sticks of dynamite at the holes as needed, as there is danger of leaving pieces about.

The diggers make the holes.

Two holes behind the diggers comes the "loader," who puts the cartridges in the hole, and places a red flag on top of same.

One hole behind the "loader" comes the "shooter."

Every 10 holes the loader may recover the 10 flags taken up by the shooter.

While it is possible for one man to load and shoot this is not advisable.

A rule should be that four men comprising the gang should not get out of sight of each other. Such a gang will complete from 30 to 50 holes a day—say a mile of poles per day of 10 hours.

SUMMARY OF RESULTS.—The dynamite method is not only easier than hand digging, but actually costs less. There is practically no danger. Greater progress can be made with the line, especially in hard soils. In the majority of cases, one stick of 40 per cent. will do the work.

A construction crew who once employ dynamite method will become enthusiastic advocates for it and will not readily return to the hand method.

As the paper tube for separating the charges of dynamite is likely to buckle, so that it may be difficult to drop it in the bore hole, it is often faster and more satisfactory to use a straight stick or piece of reed and space the small charges along it, tying them firmly.

Another very satisfactory method is to seat the bottom charge in the hole, drop in a small stick that will not fill the hole more than half full and long enough to hold the next charge at the proper place, seat the second charge on this and continue building up with alternate pieces of stick and charges of dynamite until the primer is added.

Full directions for priming and loading are given on pages 137 to 140.

Starting Log Jams

To start log jams with dynamite the charge of several cartridges or in some instances of many pounds of dynamite is exploded on or under the logs forming the key of the jam. When small charges are enough, the cartridges are tied in a bundle as when blasting ice. If charges of fifty pounds or more are necessary the dynamite may be put in a bag or left in the original wooden cases. The charge is primed with a Du Pont Waterproof Electric Blasting Cap and after being firmly secured in the proper position is exploded from the shore with a blasting machine.

Blocks in log rollways caused by rain and snow freezing and binding the logs together are broken up by exploding charges of dynamite in different places under the logs until they are loosened and can be rolled apart.

Red Cross Extra Dynamite 40 per cent. is recommended for starting log jams and for opening the rollways. See pages 137 to 149 for proper methods of priming, charging, tamping and firing.

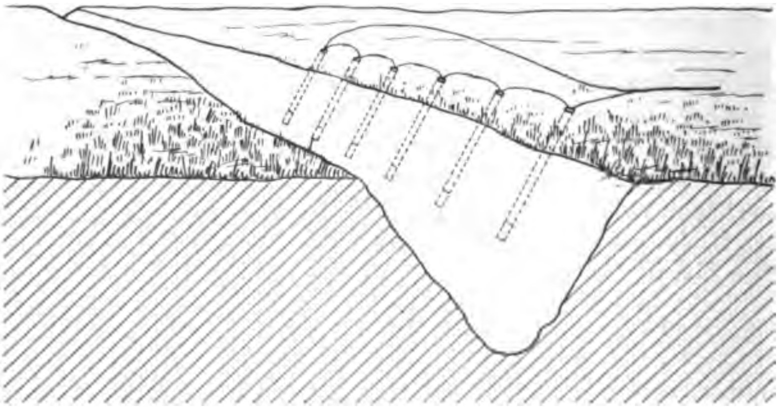
Gully Filling

When gullies are too deep, and the sides too steep to plow across in filling them, a line of holes should be put down a little way back from the edge, loaded with Red Cross Farm Powder or Red Cross Extra 20 per cent. dynamite and fired electrically. This will push enough soil over into the gully to permit the use of teams in plowing and scraping down the banks, and the shock of the blast will be sufficient to shatter the deeper subsoil so that it will absorb an increased amount of water and prevent further erosion, except under very trying conditions.

If broken boulders, stumps, logs or any other loose material is placed in the bottom of the gully before it is filled the effect will be that of a deep well laid tile drain. Through this the excesses of water will be discharged without injury to the surface. In many cases, it will be well to straighten up the bottoms of the gullies and lay permanent subdrains before the filling is commenced.

For wide shallow gullies, where the entire surface has been lost, but where the cutting has not been deep, the treatment is deep subsoiling with the spacing of the holes decreased to ten or twelve feet. In filling gullies large amounts of unaerated subsoil are exposed, and care should be taken to add humus either in the shape of rank-growing green-manure crops, vegetable litter or rough manure. Old cornstalks, forest leaves, or mildewed straw can be used to good advantage.

Specific directions for electric blasting are given on pages 136 to 149.



LOADING TO BLAST DOWN BANK OF GULLY

Scrapping Old Machinery

Breaking up old machinery, such as heavy castings or steam boilers, can be readily done with dynamite.

For scrapping a boiler use only 40 per cent. or stronger explosives. Remove the dynamite from the shell and distribute in a continuous cord about half an inch in diameter all the way around the boiler, and secure it with a heavy mud cap. This can be placed along one of the seams more easily than on the smooth plates. When detonated such a charge will cut the plates almost as neatly as a shearing machine, and will reduce the cumbersome boiler to a size that can be handled.

For breaking heavy castings mudcapping is practiced the same as on boulders. Sometimes a hole in the casting can be used for a block hole and loaded as described on page 153.

The accompanying illustration shows a large cast retort that was broken by filling with water and firing a small charge of Red Cross submerged well under the surface.

EMPORIUM, PA., March 30, 1914.

Mr. George Frank Lord, Managing Editor, Du Pont Magazine, Wilmington, Del.:

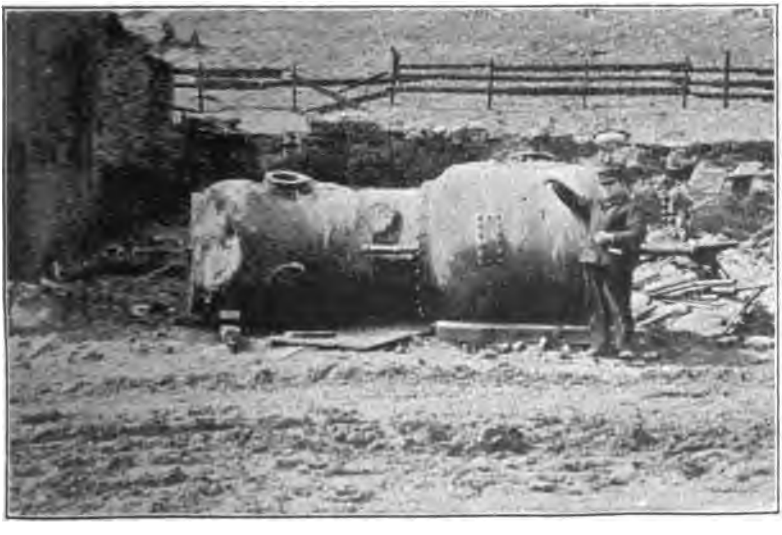
DEAR SIR:—I hand you herewith a set of pictures showing our method of breaking cast-iron retorts weighing 6,000 pounds each with Du Pont Dynamite, Red Cross Extra 40 per cent., using a stick 1¼ x 4 inches in size, and one 4-foot No. 6 Du Pont Electric Blasting Cap to each retort.

The retorts are filled with water and the cartridge is suspended in the retort and fired. In this manner we broke the 18,000 pounds cast scrap with ¾ pounds of dynamite and three electric fuzes.

By this method there is very little danger from flying pieces. The pictures were taken not over 25 feet distant, and none of the pieces were thrown that far.

Trusting this may be of value to you for the Du Pont Magazine, I am,

Very truly yours,
W. W. WEIMAN.



THE RETORT BEFORE THE BLAST

THE RETORT AFTER THE BLAST

Blasting to Increase Action of Tile Drains

Often tile drains are properly laid so far as engineering is concerned, but fail to drain the land because the subsoil is too impervious to permit the water, except that from the soil immediately disturbed in digging the tile trenches, reaching them. To correct such a condition the subsoil should be cracked so that the excess water can seep into the drains and be carried away. This is done by subsoil blasting, using slightly lighter charges than is ordinarily advised. Care must be taken to place the charges not closer than 9 or 10 feet to the drains.

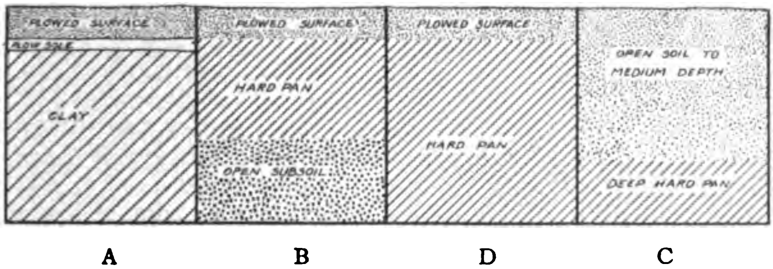
A better practice on such soils, especially where the hardpan is too deep to be thoroughly reduced by blasting, is to shatter the subsoil with Farm Powder or 20 per cent. Red Cross Extra to a depth greater than the drains are to be laid before the ditching for laying the tiles is begun. Instructions for priming, loading and firing are given on pages 137 to 149.

Before undertaking work of this nature a very careful study should be made of the nature and depth of the hardpan. Care must be exercised at all times if the best results are to be obtained.

Shattering Subsoil and Hardpan

Plowing and cropping the same soil year after year robs the top soil of much of its original plant food. Impervious clay subsoils and hardpan prevent deep rooting of plants, the percolation of water into the subsoil where it should be stored to carry the crops through the dry spells that occur nearly every summer. When such soil conditions are corrected, even to a depth of eighteen inches by mechanical means, marked increases are noted in the crop yields. These benefits can be materially increased by making the tillage four or five feet deep with Red Cross Farm Powder or Red Cross Extra 20 per cent. Dynamite.

In doing this work the best results are obtained by spacing bore holes about 15 feet apart to a sufficient depth to permit the shattering of the impervious material. In deep clays of uniform nature, such as is represented in Sections A and C of the accompanying sketch, the holes should be put down to a depth of about 3 feet. Where the hardpan material is similar to that in Section B the holes should be put down a little more than half way through the hardpan. They should not go below the hardpan, as there is danger of the blast lifting the hardpan in large chunks, rather than shattering it. Where it is desirable to shatter soils similar to the one represented in Section D, the holes should be put well down into the deep hardpan, the depth being governed by the depth of the open surface soil. Each hole is charged with one-half cartridge of 1¼ x 8-inch Red Cross Farm Powder or Red Cross Extra 20 per cent. Dynamite. Exact advice for putting down the holes and charging them is given in the text and illustrations on pages 135 to 137, and directions for making the primer are given on pages 137 to 139.



DIFFERENT TYPES OF HARDPAN

In some cases of hardpan like cemented gravel or hard shale, slight variations must be made in the method of loading. In such cases it will be better to materially increase the amount of explosive used or to use a half cartridge of Red Cross Stumping Powder or Red Cross Extra 40 per cent. Dynamite.

Subsoil blasting should be done only when the subsoil is dry, because wet subsoils are difficult to shatter, and the tendency of the explosion is to create a large cavity or pothole at the base of the blast. This does not benefit the land. Where the soil, as in "A," has a loose subsoil, destroy the plowsole by deep surface tillage and blasting will not be necessary.

Tree Planting

The methods employed for making boreholes and loading for tree holes are exactly the same as those given for shattering subsoil and hardpan. The explosive advised for a normal subsoil is one-half cartridge of Red Cross Farm Powder or Red Cross Extra 20 per cent. Dynamite. The depth and amount of loading should be similar to that given on the preceding page, making the same variations in quantity of dynamite.

The common practice is to plant the trees shortly after the holes are blasted, in which case it will be necessary to examine the bottoms of the holes and fill any pothole created by the blast with soil to prevent the trees settling too deep after the first heavy rains. (See illustrations, showing every step of the work on page 52.)

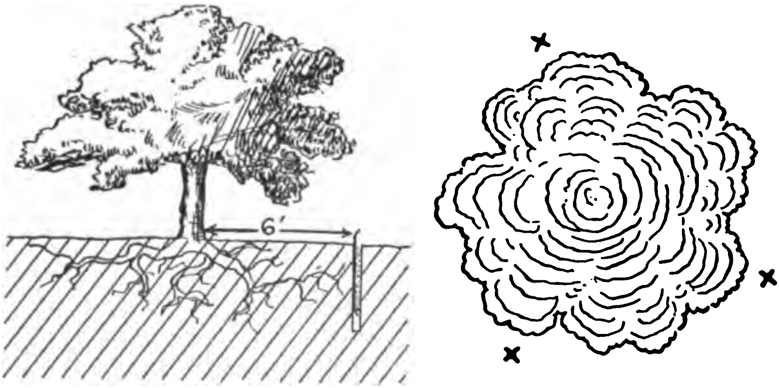
Another practice, and a good one, especially for spring planting, is to blast the holes during the late summer or fall, and allow them to stand without further treatment until planting time.

Where the soils are deficient in plant food or humus, a bushel or more of well-rotted manure should be put in the holes and allowed to mix with the soil during the winter. The addition of a handful of finely ground limestone should also be used if the soils are sour.

Cultivating or Rejuvenating Old Fruit Trees, Shade Trees, Vines and Bush Fruits

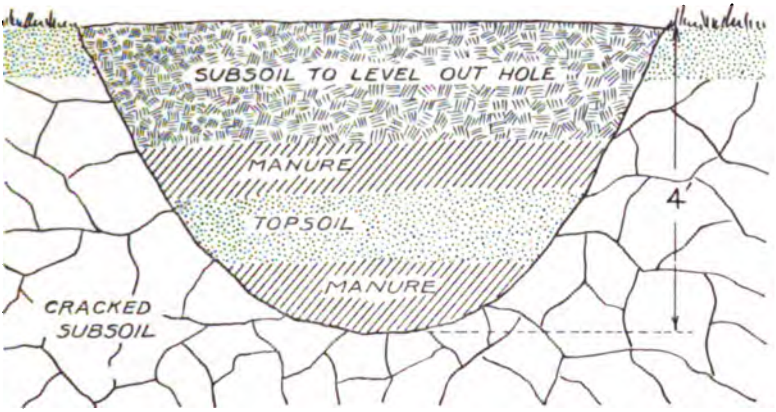
The object of blasting around old trees and vines is to open up the subsoil so that the roots may spread farther and go deeper, to increase the amount of plant food available for the roots, to establish better drainage and to increase the water-holding capacity of the soils. Blasting around root-bound trees or in resistant subsoils is strongly advised. The actual blasting is similar to the blasting for subsoiling and tree planting.

Ordinarily it is better to blast on one or two sides of a tree the first year and blast on the remaining sides one or two years later. The blasts should be placed not closer than six feet to small trees, and should be slightly beyond the spread of the branches in large trees.



For Small Tree For Large Tree

LOCATION OF CHARGES FOR REJUVENATING TREES



METHOD OF TREATING BLASTED HOLES IN POOR SOILS

Where the subsoils are deficient in plant food or humus, excellent results are obtained by putting down holes a few feet beyond the spread of the branches to a depth of about 4 feet and loading them with a sufficient amount of explosives to blow out a hole. This should then be filled with alternate layers of manure and soil, or with a mixture of manure and a suitable fertilizer.

Where trees tend to develop a strong tap root, but are stunted by a stratum of hardpan lying immediately under them, relief can be had by starting a hole two or three feet away from the trunk and driving it diagonally under the tree into the hard material. Unless this hole is three or more feet deep the charge should not exceed one-third of a cartridge of Red Cross Farm Powder and not over one-half a cartridge even then. Great care must be exercised in this method of loading, not to loosen or blow out the tree. Except in extreme cases, we advise the loading to the side.

When blasting around or under growing trees materially prunes the roots, the tops should be cut back to temporarily reduce transpiration to correspond with the reduced ability of the roots to obtain a sufficient amount of moisture. The roots will then put on vigorous growth and absorb increased amounts of plant food and moisture to nourish an increased growth of top, and, in case of fruit trees, an increased production of fruit will result.

(See pages 140 to 148 for methods of loading and firing.)

Explosives for Tree Planting and Subsoiling

For tree planting in the West Coast States we recommend Repauno Stumping Powder or Du Pont Stumping Powder, either of which will do fully as good work as the explosives recommended for these purposes in other sections of this book.

Ice Blasting

Often in Spring when ice in streams starts to move, it gets choked in narrow parts of the stream or by some natural or artificial obstruction. Then an ice gorge or jam is formed which causes the water to back up, flooding the surrounding territory above and often carrying away bridges and other structures and causing considerable damage.

By the use of explosives at the proper time the damage can often be averted. Ice begins to move out in various localities about the same time each year. Usually there is sufficient warning when to expect the break to occur, by several days' thaw or rains. It is a good plan to anticipate the moving out as soon as the Spring thaw begins, by blasting the ice while intact on that section of the stream where the gorge or choke usually occurs. The method of procedure is as follows: With ice spuds or cutters and bars, chop holes about six inches to eight inches in diameter through the ice to the water. Holes should be spaced from fifteen feet to twenty feet apart.

A charge of from six to eight cartridges of low freezing explosives 40 per cent. strength should be lowered in each hole so that the explosive is in the water and below the ice. The cartridges can be tied together in a bundle, and one cartridge of each bundle should be primed with a No. 6 Electric Blasting Cap. To prevent the loss of the charge the wires can be fastened to a stick of wood laid across the hole on surface of the ice. Several holes should be connected together in series and fired with a blasting machine.

It has been found that the ice is broken up more by the wave action of the water than when the charge is imbedded in cracks or holes dug in the ice. It is best to fire the holes electrically, but if no blasting machine is at hand a cap and fuse will answer, but then only one hole at a time can be fired.

If this is done all through the narrow section the ice is practically "honeycombed," so that when the water and ice from above comes down, it gives way readily and causes no damage.

If the gorge or jam has actually occurred a charge of from five pounds to twenty-five pounds of dynamite should be loaded in a crevice, or dug hole, at what appears to be the weakest part of gorge. Several such charges can be distributed at various points in the gorge and connected together and fired electrically. If the first blast does not start the gorge, the same process should be repeated with increased charges until it gives way.

To break up floating ice so that it will not bank up, forming a gorge, charges of dynamite can be exploded on the surface of the ice, the size of the charge depending on the thickness of the cakes.

If they are large blocks it may be possible to get on the ice from shore or boats and successive charges of several cartridges can be exploded with fuse and blasting cap until the ice cake is properly broken.

If stream is narrow the charge of explosives can be thrown on the ice from the shore, or, if running swiftly the charge can be dropped on the floating cakes from down-stream side of bridges. The dynamite should be tied in a bundle and one cartridge in each bundle primed with a blasting cap and fuse. A block of wood or stone can be tied to charge as an anchor to prevent its rolling off the cake of ice. The fuse should be lighted before thrown and ample length allowed for a getaway. Fuse burns about two feet per minute, so from two feet to three feet is sufficient. The place where fuse enters blasting cap should be smeared with soap or grease to protect charge in cap from water.

Watering places for stock along the banks of streams can be easily kept free from ice in winter by the use of a little dynamite from time to time.

Lack of Previous Experience No Bar

The fact that you may never have used dynamite previously is no reason why you shouldn't begin now. There is nothing difficult about blasting if the instructions in the Farmers' Handbook are carefully followed. Thousands have successfully undertaken agricultural blasting work of various kinds with no other training or instructions than they were able to get from the Handbook. Read what Mr. Edgar Schliewen, of National City, Cal., writes on this point. He says:

"The way I became acquainted with your dynamite was as follows: I have a small farm in southern California. I was setting out 200 young fruit trees. To set 200 trees in spade-dug holes is a job. After I had dug about twelve, I began to look about me for a new method. While thinking about it, the idea of using dynamite occurred to me, and so I bought a few pounds. *I had never used it before* and had rather a vague idea of its use. My first shot was fired with much fear and apprehension. Instead of seeing the entire place demolished, I found a fine hole dug all ready to set out the tree. I looked at the spade and said, 'Never again!' I then began to experiment further and learn what kinds of charges to use for different depths and soils, and I soon became rather proficient. The neighbors, seeing my success, began to come for advice. Then I thought, 'Why not make a little money out of it?' and I began looking for additional information on the subject. My letters to you followed. I have since given several demonstrations on my place, each of which was a marked success. The work is interesting, and I enjoy it."

Also note the following from Mr. J. F. Pitman, of Alabama:

"To-day I have been blasting out stumps with your dynamite, and I'm making good progress. I have about 200 acres of pine stumps on my farm, the stumps running all the way from ten to thirty to the acre. There is a lot of this kind of land all around here. Some of the farmers have tried stump pullers without success. One stump I blew out to-day had a diameter of three feet four inches. Five cartridges (2½ lbs.) took it out. It had a tap root 24 inches in diameter, running 8 feet into the earth. In doing this work I am going altogether by the instructions in the Farmers' Handbook, which you sent me."

What To Do When Wanting Explosives

In the foregoing, Du Pont Explosives and Blasting Supplies have been carefully described, and the way to store and use them explained. When blasting is contemplated refer to the section on the kind of work to be done and find the kind of dynamite recommended for that work and about how much will be required.

If the dynamite is to be used for blasting stumps, multiply the number of stumps to be blasted by the number of cartridges for a stump the size they will average and divide the number of cartridges by two to get the number of pounds required.

We prefer to sell through local dealers when possible. If we have a representative in your locality carrying stock, your order should be forwarded to him to be filled from his own stock. If we have no dealer nearby, we will make shipment from our nearest distributing point, and if it is to be a charge account, the goods will be invoiced to the storekeeper who has agreed to carry your account, but shipment will be made direct to you.

You can buy any quantity of dynamite from one cartridge up from local dealers who have stock on hand, but on orders sent to this Company for direct shipment, broken lots cannot be purchased. The smallest direct shipment that we can accept for dynamite is 25 pounds; for caps, 100; for fuse, 100 feet. Orders for larger quantities must be in multiples of these figures: for instance, 50, 75, 100 and upwards pounds of dynamite; 100, 200, 300, etc., caps; 100, 200, 300, etc., feet of fuse.

The minimum freight charge is on the basis of 100 pounds; hence freight will be the same on 25, 50, 75 or 100 pounds.

As soon as you have sent in an order, be sure to notify your local freight agent, so that he may advise you promptly of the arrival of the shipment. It is required by law that explosives be removed from freight stations within 48 hours after their arrival. Order about 3 to 4 weeks before you need the dynamite and supplies.

E. J. Dickson

FARMERS' HANDBOOK

[illegible]

✚ RED CROSS ✚ DYNAMITE

E. I. DU PONT DE NEMOURS POWDER COMPANY

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DU PONT

FARMER'S HANDBOOK

INSTRUCTIONS IN THE USE OF DYNAMITE FOR CLEARING LAND PLANTING AND CULTIVATING TREES, DRAINAGE, DITCHING AND SUBSOILING

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E. I. du Pont de Nemours Powder Co.
Established 1802
Wilmington, Delaware

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HOW TO READ AND USE THIS BOOK

This book has a double purpose, namely, to present the advantages of using Red Cross Dynamite on the farm, and to give detailed instructions as to the best methods of using same.

Every farmer, orchardist or other person interested in a farm or orchard should read this book from cover to cover at least once, in order to get a general idea of the utility of Red Cross Dynamite on the farm, and how to handle it safely, economically and efficiently.

Next consider how you could use Red Cross Dynamite to advantage on your farm or in your orchard. Then figure out how much Red Cross Dynamite you need and order it at least three weeks in advance of the time you expect to use it. Then spend your spare time during those three weeks in carefully studying all of the instructions that pertain to the particular uses of Red Cross Dynamite that apply to your proposed work.

It is especially necessary that you become thoroughly familiar with the method of priming Red Cross Dynamite cartridges and of charging bore holes.

A great deal of information can also be obtained by reading the letters from farmers and orchardists who have had experience in the use of Red Cross Dynamite, as their descriptions of methods employed contain many good practical points.

It must be borne in mind that to the average farmer, dynamite is something absolutely new which he has never even seen and knows practically nothing about. He cannot therefore do too much reading about Red Cross Dynamite so that when he does handle it he will not injure himself through ignorance or carelessness, but will use it intelligently, safely and profitably.

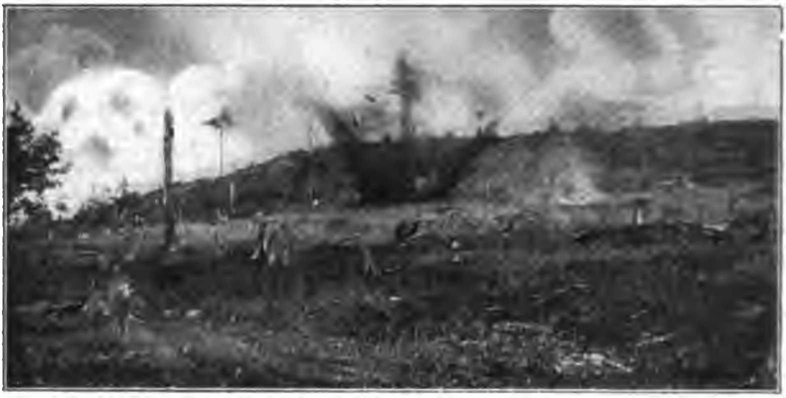


FIG. 1.—WASTE LAND NEAR HIBBING, MINN. FARM OF G. G. HARTLEY

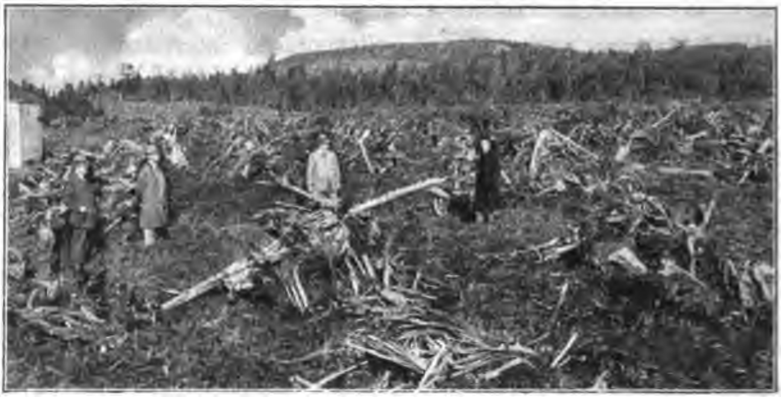


FIG. 2.—SAME LAND WITH STUMPS BLASTED

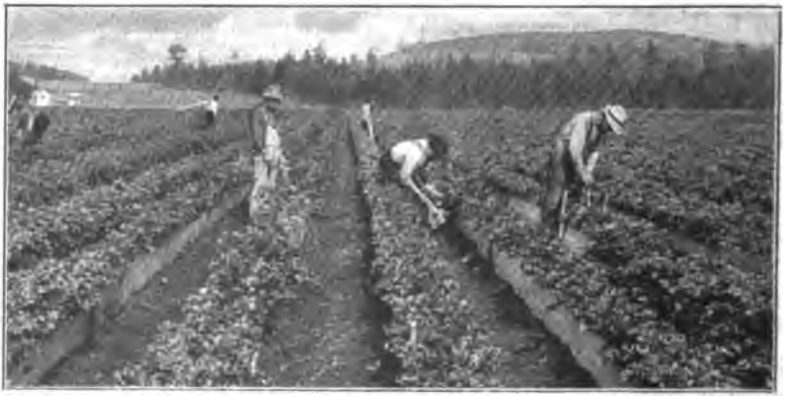


FIG. 3.—SAME LAND 10 MONTHS AFTER BLASTING, YIELDING $800.00 WORTH OF CELERY PER ACRE

Clearing Farm Land With Red Cross Dynamite

Ever since the first white man started a permanent settlement in this country, the transformation of forests into farms has been carried on continually and at an ever-increasing speed. So great is the magnitude of the land clearing operations today, so large is the annual expenditure in this work, that it has become a factor of prime importance in the national economy and the necessity for a careful study of all its phases to the end of improving the various methods now in practice, is everywhere recognized.

If, after the passing of the wood chopper and the sawmill, the land were ready for the plow, there would be no problem to solve; but a great area covered with stumps, thirty, fifty, a hundred, two hundred to the acre—with a number of boulders scattered here and there—is very far from a crop-bearing condition.

When the farmer of the old school already had more acres than he could cultivate—a few acres that needed clearing of stumps and boulders—a few acres that might have been drained—a few acres that were especially adapted to growing a particular crop but hardly seemed worth while to "bother with"—these acres naturally were neglected.

Even some of the new school of farmers, pledged to the new methods of cultivation, are leaving those old, obstructing features of soil surface to the elements, accepting the fact that, as they have never been removed, it isn't worth while at this late day to spend time and money on them.

Now, READER, does not the above apply to your case? Haven't you one particular field containing stumps and boulders which is an eye-sore which you think it is hardly worth while to bother with? Have you ever stopped to consider the cost of the damage to your implements these obstructions have caused you? Have you ever reasoned that you have been losing yearly HALF A DOLLAR'S worth of produce which might have been grown in the ground occupied by each stump or boulder, and cultivated with less effort than is required to dodge them? We ask you to reason these points out in order that you may recognize the DOLLARS AND CENTS which you could today have deposited in your bank, if you had used a little Du Pont Red Cross Dynamite for their removal.

You undoubtedly realize that in growing "two blades of grass where only one grew before" you are receiving from the same amount of labor and from the same investment of dollars, an increased yield of 100%—a premium which accrues to the ledger balance under the general heading of " Enterprise."

You must also appreciate that an acre of land which lies non-productive for a season is comparable with its money value buried under a stone, or with its value in machinery lying idle under the roof of a manufacturing plant.

Therefore, to make every acre of your farm profitable becomes of first importance, because land that lies waste is taxed and has chargeable to it year after year its proportionate fixed expense.

In this section we endeavor to bring before you the many advantages to be derived by clearing your farm of stumps and boulders by the use of Du Pont Red Cross Dynamite.

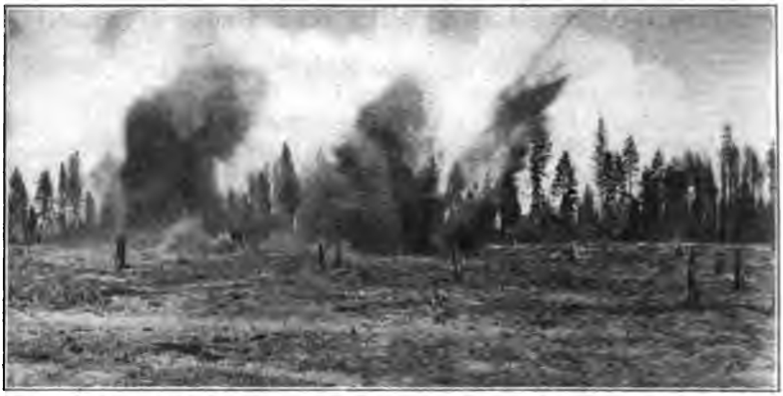


FIG. 4.—ARCADIA ORCHARD CO., DEER PARK, WASHINGTON, CLEARING THE LAND

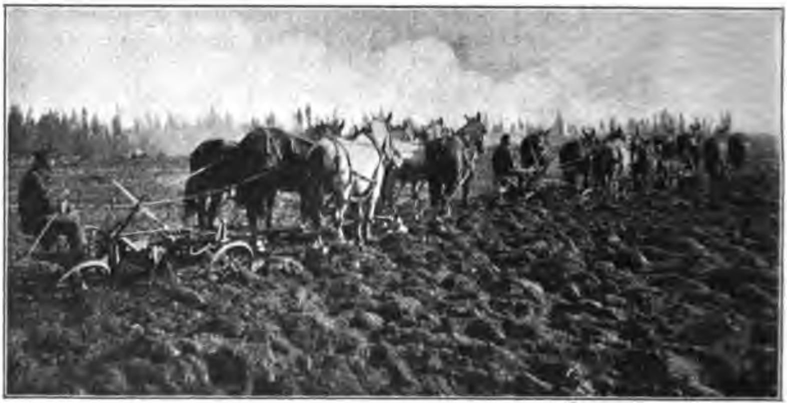


FIG. 5.—SAME. FIRST PLOWING OF CLEARED LAND

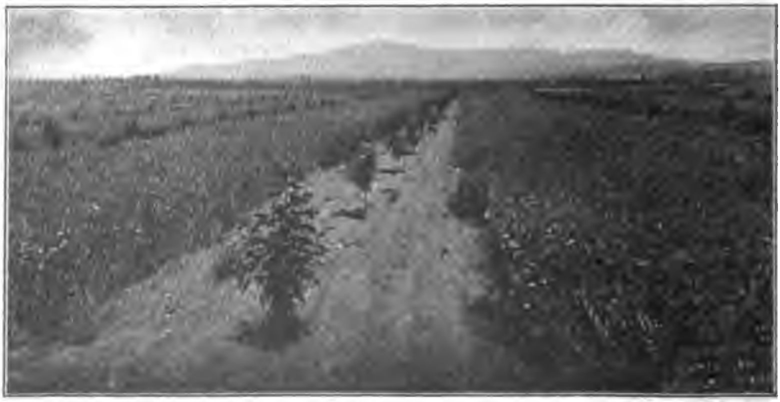


FIG. 6.—SAME. PLANTED WITH FRUIT TREES AND PEAS

Why Red Cross Dynamite is the Best Stump Remover

When Red Cross Dynamite is properly used, stump or boulders are not only blasted out of the ground but are broken into pieces which can be easily handled.

Red Cross Dynamite a Money and Labor Saver

Since I learned how to use dynamite, I have discarded the stump puller entirely, and will not use it again, as I figure dynamite is a money and a labor saver, as well as a time saver, and if we are to make any headway in this section clearing land, we must use dynamite or we will not have farms until we are old men.

The stumps often average 100 to the acre, and to get these out with a stump puller would require an enormous amount of labor and in addition the wear and tear on harness, and strain and chances of injuring horses must be considered. Dynamite removes all these difficulties, and also can be used under conditions where it would be impossible to employ team labor.

Stumps when split with dynamite burn easily. Stumps pulled with a puller have to be repiled sometimes several times, in order to get them to burn. Besides the extra labor involved in burning, the humus is entirely burnt out of the soil adhering to the roots of the stumps, and this loss is a large one, as we are beginning to learn.

The use of dynamite for blasting boulders is becoming very general, and is so cheap as to make the use of other means of disposing of them ridiculous.

For ditch digging in wet and low places, dynamite certainly is the thing, as it cheapens the cost of doing the work, permits of ditching being done where it is impossible to get in with machinery and horses, and also allows of the work being done in a short time.

Last year (1911) I used 1,300 pounds of Red Cross on about thirty-five acres and will use nearly as much this year, and cheerfully recommend it for land-clearing purposes.

JORGEN JUHL, Askov, Minnesota.

When a stump is properly blasted but little of the soil is thrown out with it, and it is not necessary to spend time and money clearing the earth from roots. Burning out stumps is an exceedingly slow and incomplete process and besides destroys the humus in the soil for many yards around so that several years of special fertilization of that spot is necessary.

Only a very small outlay is necessary at one time when Red Cross Dynamite is used, and two men can work at as little relative cost as a dozen or a hundred.

Red Cross Beats Stump Puller in Many Ways

The 700 stumps on the ten acres that I have cleared have been blasted with dynamite, with the exception of about two acres, which was done with a team and stump puller. I find the dynamite so much cheaper and better that I cannot afford to use a stump puller.

Dynamite will break the stump and leave it so that it can be handled, while a stump puller leaves it so large that it is impossible to handle without breaking. I consider the latter method entails an expense of about 50 per cent. more.

I also find that the stump is free from dirt when dynamite is used, which is not the case with a stump puller. I find that the ground works easier and is more productive where dynamite is used, as it shakes up the soil and breaks the hard soil under the stump which a puller will not do.

Also, for the boulders it cannot be beat, as one can remove a boulder in a few minutes, which a stump puller will not handle, and which has to be drilled and broken in pieces before it can be handled even if pulled from the ground.

I think a man and a box of dynamite will remove more stumps in a dav than two men and a team with a stump puller.

E. L. STEVEN, Remer, Minn.

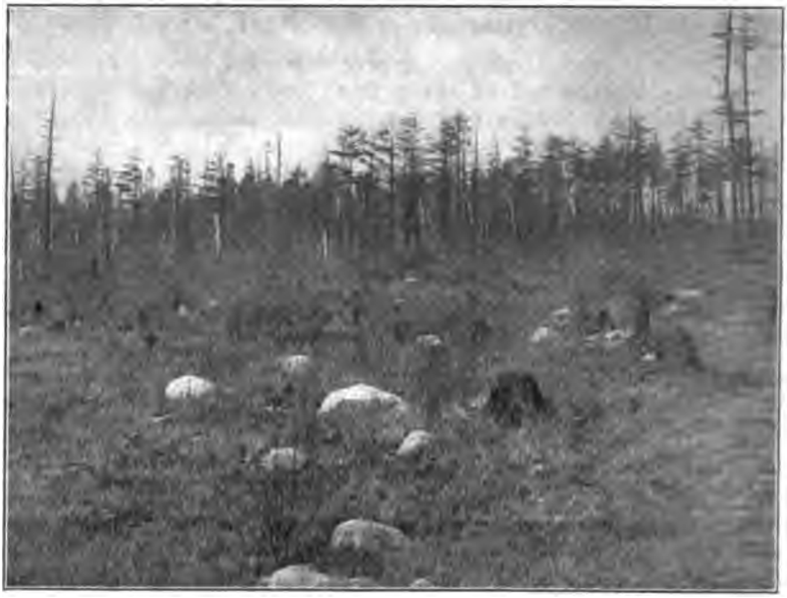


FIG. 7.—A TYPICAL PIECE OF WASTE LAND

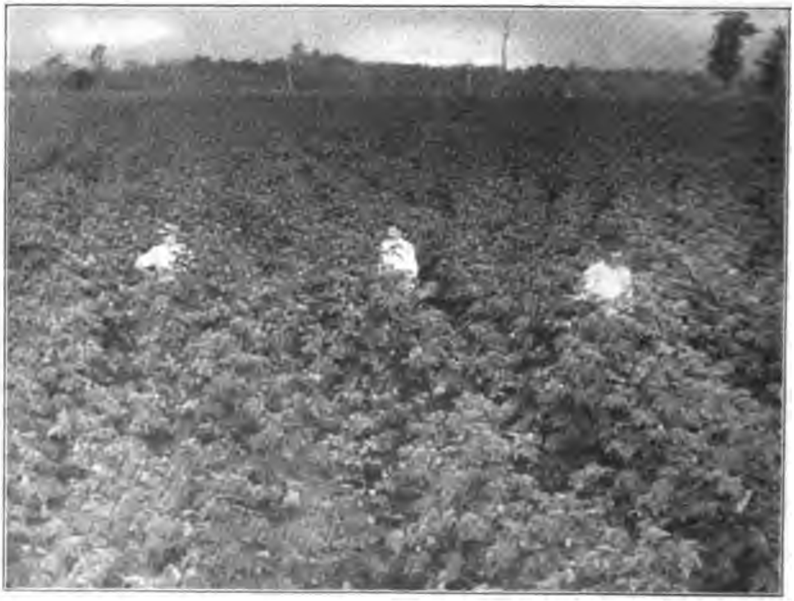


FIG. 8.—FINE COTTON ON RECENTLY CLEARED LAND. PLANTATION OF H. J. McELROY, CUBA, ALA.

Red Cross Superseding Stump Puller Everywhere

It is a matter of considerable interest, to one who takes the trouble to investigate it, to see how Red Cross Dynamite is superseding the stump puller in land-clearing operations. Wherever the two methods have come into close competition, the latter has been completely vanquished. Says a prominent Farmers' Institute man, in an article in the Minneapolis Farmers' Institute Annual for 1908: "After using the stump puller for years I have laid it aside and shall never take it to the field again, simply because I cannot afford to use it." We quote from the report of an Eastern Experimental Farm: "There is a contractor who has for a long time claimed that he can clear land much cheaper and better with a stump puller than with dynamite. We determined to have it proven to us and so signed a contract to have 10 acres cleared in 30 days. It is now 60 days and the stumps are partially out of about 2 acres. In fact the remaining roots are so numerous that it is almost impossible to plow. Dynamiters go in next week."

A bulletin from an Experimental Farm in the Lake States cut-over region, says: "Dynamite is now used almost exclusively by men who have made a study of clearing land. It is surely the quickest, easiest, and most practical way to remove stumps and boulders yet known."

Without commenting on such unquestioned and authoritative statements, let us consider a few of the advantages obtained by using Red Cross Dynamite.

1. FRAGMENTATION AND DISPOSAL. Dynamite not only removes the stump but also breaks it into pieces which are easily handled. When stumps are pulled, they cannot be disposed of otherwise than by burning in the field. Often this is rendered difficult by the dirt which pulls up with and remains attached to the stump. Dynamite so shatters the stumps that all dirt is removed and a great quantity of excellent fuel is gotten from the fragments.

$30.00 Worth of Red Cross Dynamite Increases Value of Farm From $25.00 per Acre to $75.00

I have recently finished clearing out oak, chestnut, poplar and walnut stumps ranging from eight inches to eight feet in diameter, on all of which I used 40 per cent. Red Cross Extra Dynamite.

This work cost me, including the labor, on an average of 30 cents per stump or $30 per acre; while by any other method the work would have cost at least 50 cents per stump or $50 per acre. Furthermore, this land was worth but $25 per acre before stumping it, while its present value is from $60 to $75.

These stumps were mostly large; some were eight feet across, but I took them out with ten and twelve sticks of dynamite. I don't think much of the stump puller; the ones on which the stump puller was used had to be dynamited before I could remove them, using as high as five sticks on some to get them torn up. We have tried most all ways of getting them out and find Red Cross Dynamite the best.

C. E. SMITH, Afton, Tenn.

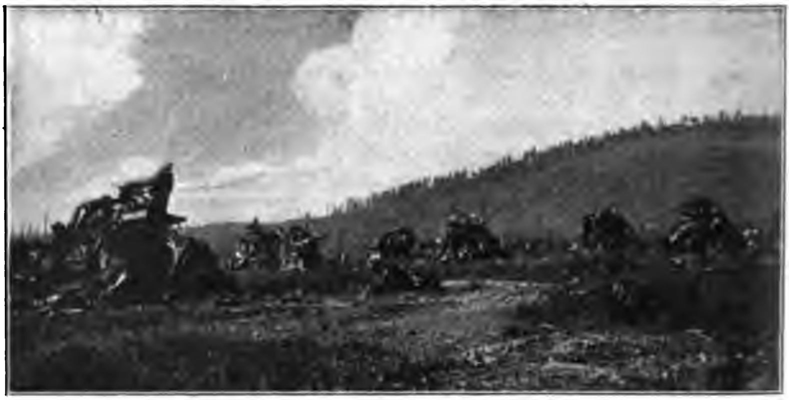


FIG. 9.—BLASTED STUMPS. MICHIGAN LAND AND LUMBER CO., CAREYWOOD, IDAHO

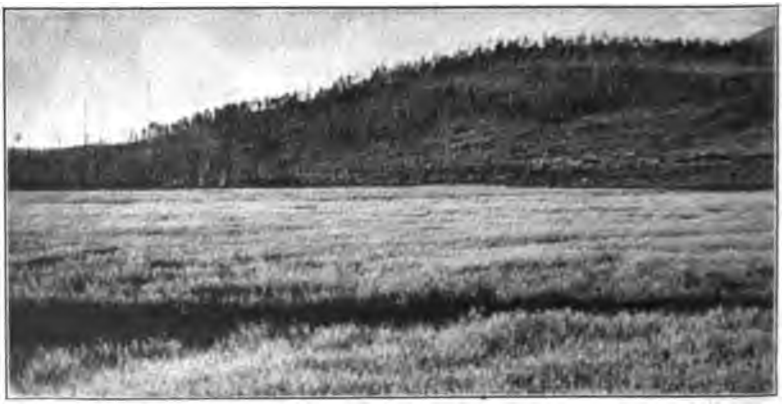


FIG. 10.—SAME LAND BEARING FINE CROP OF OATS

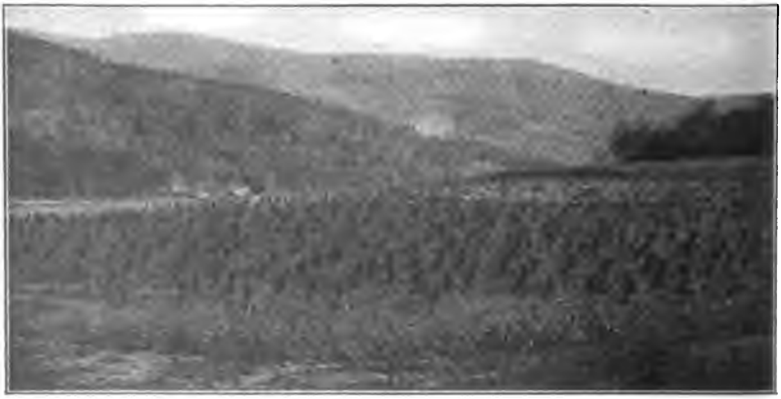


FIG. 11.—CORN ON CLEARED LAND, 75 BUSHELS TO ACRE, ONE YEAR AFTER CLEARING. FARM OF J. C. LOOKER, RIXFORD, PA.

2. FOR SWAMP WORK. In swampy or wet grounds any other method of stump removal is out of the question. Red Cross Dynamite will do the work anywhere man can place it.

Land Cleaned, Drained and Subsoiled at One Operation and at One Cost

I have had quite some experience with dynamite for blasting stumps and have had great success. Altogether, I have cleared about twenty acres of 600 gum and cypress stumps from one to five feet in size, using Du Pont Red Cross 40 per cent. Dynamite.

Dynamite is the cheapest way to clear land by half and more, and if it is done right and in tight land, it loosens it up so water sinks and the air gets in and makes it produce much better.

W. L. WOOD,
Morrilton, Ark.

3. SPEED OF OPERATION. One man with a reasonable amount of skill should be able to blast out THREE stumps during the time employed in taking one out by any other means, as there is no waste of time and labor cost in cutting the roots, breaking of machinery, etc.

Why Red Cross Dynamite is Faster Than Stump Puller

I have used both the stump puller and Red Cross Dynamite, but have abandoned the stump puller because it costs too much in labor and breakage, and, worst of all, it is too slow. Try as you may, you will be compelled to dig out and cut the biggest roots, as there are no stump-pullers made strong enough to pull stumps of any size without digging and cutting anchor roots.

Nature made the stump and anchor roots on which the tree stood sufficiently strong to resist any ordinary storms, and it is but rarely that you see a tree uprooted by anything less than a tornado. Now if we are going to uproot or remove this stump by a pull, we will have to get one stronger than any it has ever before been subject to, before the tree was cut. In other words, we will have to make a chain stronger than the tempest, a cable rope and machinery stronger than the winds, not to mention the rules of leverage, as the wind gains power on the stump by the height and amount of limbs on the tree. The stump puller does not have any advantage in that respect, as it should remove the stump by a direct pull, and an ordinary stump will resist an enormous strain.

Dynamite works to the contrary; its work is underneath the stump, with a sudden jerk and an explosion bursting the roots before they have a chance to resist any power.

As to comparison of costs in the two methods: With a puller, it requires about three men, one team, and costly repairs. A machine, no matter how strongly made, when subjected to violent strains will weaken and some parts of it will break. Now, a good day's work with puller and gang (10 hours), three men at $2—$6; one team at $1, totaling $7 per day besides repairs, will remove not over fifteen stumps, more often not over ten.

With dynamite, the same amount of men and other expense will remove in the same length of time at least forty stumps, and, besides removing the stumps and breaking them up into pieces more easily handled, will also, while it blasts a stump, break up hardpan if any exists.

CLAUD HANSEN,
Jamestown, Kan.

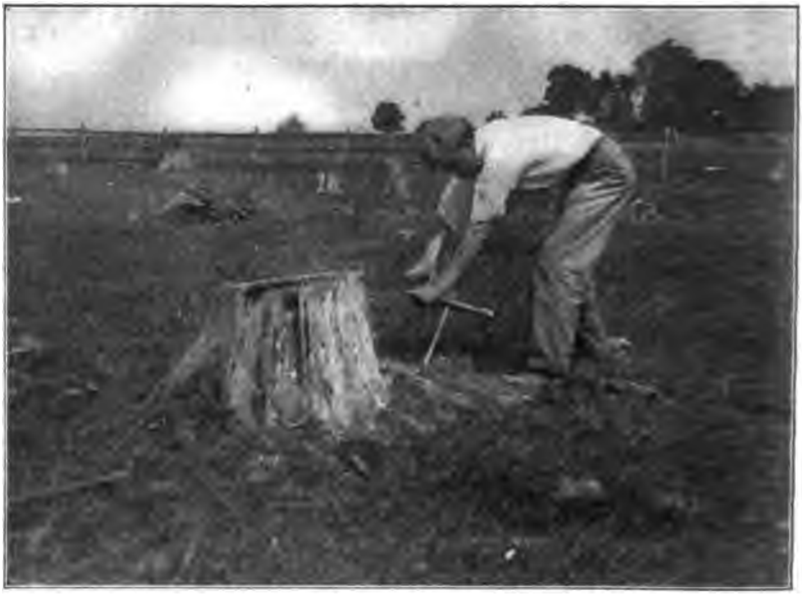


FIG. 12.—BORING HOLE UNDER STUMP WITH DIRT AUGER. THIS IS NOW USUALLY DONE WITH A PUNCH BAR

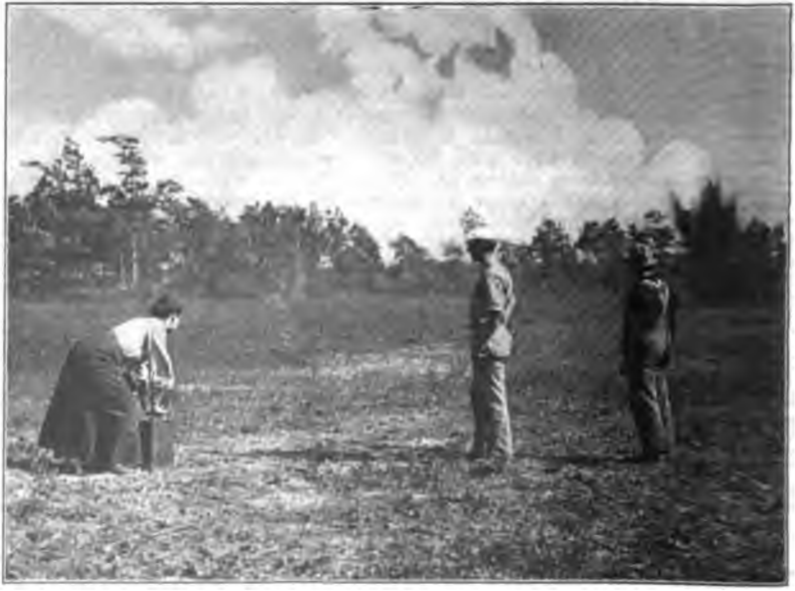


FIG. 13.—WOMAN OPERATING BLASTING MACHINE

4. COST. Taking into consideration initial expense, labor, teams, replacing broken machinery, and time wasted, Du Pont Red Cross Dynamite is at least twice as economical as any other method yet devised.

Stump pullers are costly. A good quality one-horse machine cannot be secured for less than $100 to $125. One horse, a man, and a boy are needed to operate it. The cables of this type, being rather light, cannot be used for heavy work, which oftentimes necessitates the services of a heavier machine. Such a one would cost from $175 to $250 and would require a team and at least three men to work it. The initial cost then is prohibitive to many farmers, for a machine of this sort is not one which will be used year after year, like a harvester. After the stumps are removed, it is no longer of use, and you have doubtless seen, on more than one occasion, an old puller, slowly being converted into iron rust, in some far off field corner. Wages, cost of repairs, delays caused by the breakages, which inevitably occur, with resulting loss of time on the part of a crew of men, all these join to bring the cost of operation up to a high figure.

Large stumps have to be split with explosives and loosened for the puller. This necessitates the handling of each piece separately, taking considerable time. A little Red Cross Dynamite put under that stump would have entirely removed it and quicker too. The initial cost of dynamite is trifling and it may be purchased as needed, so that there is no depreciation in value. One man can blast stumps as well as two, so that every farmer can do his own work if he wants to without hiring extra men.

Stump pulling machines are not furnished with sweep or bed-pieces, which the farmer must make for himself. There is need for strong cables, spreader chains, whiffletrees, hooks, and like details for the strain upon these parts is enormous. He must have at hand material to replace any of these when broken, and a set of axes and mattocks to assist the machines. Where the ground contains stone or gravel, the latter become rapidly dulled, and require frequent sharpenings. In some parts of the South it is the custom to use both a yoke of oxen and a team of mules with the machine, the first to do the actual pulling, and the last to move the machine from place to place. The blaster needs very few tools and they are easily carried.

Because of the different amount of work done by dynamite and by stump puller, in a given period of time, it is impossible to compare the costs of each per day, at least directly. It is more feasible to compare the cost per acre or per averaged-sized stump, because blasters seldom keep accurate accounts of the different items, and owners of pullers are likewise neglectful; it is not easy to get hold of any accurate figures. We are able to furnish statistics as to the relative costs of the two methods in the Southern Pine regions. We are indebted to the Mississippi Agricultural Experiment Station, for the basis of the computation.

Cost With Mechanical Puller

Puller and two yoke of oxen, per day	$5.00
Three men at $1.50 per day	4.50
Total	$9.50
Number of stumps averaged, per day	40
Cost per stump 1-40 of $9.50=	$ .24

Cost By Blasting

(Labor figured at $1.50 per day)

Cost of boring stump	$ .025
Cost of charge of dynamite (average)	.07
Cost of detonator	.01
Cost of fuse	.01
	$ .115 or 11c.

This indicates a saving of at least 12c. per stump by the use of dynamite. Figuring 100 stumps to the acre, which is certainly not excessive, the saving will be $12.00 per acre.

The extremely low cost of blasting a stump is further illustrated by these figures which we quote from the Engineering Contracting Magazine of May 13, 1908. They refer to the blasting of 3,500 stumps 18 inches to 7½ feet in diameter, averages, of course, being given. This work was done on Long Island.

Cost per Stump

Labor (at $2.00 per day)	$ .059
Dynamite	.086
Caps	.008
Fuse	.009
Total cost per stump	$ .162

By preparing the charges the evening before, one man blasted 100 stumps in one day, thus reducing the labor item to a little over 2c. per stump. It will be observed that these were very large stumps. Of course, the skill of the blaster counts for much. The more care and judgment is used, the more economical the blasting.

Dynamite Cheaper Than Stump Puller

I blasted from my property 1,000 white pine stumps averaging about two and a half feet, all of which were removed very successfully with Red Cross Dynamite.

This land was always unproductive prior to 1910 when I started to farm, but by removing these stumps I have reclaimed about eight acres, which were planted to corn and potatoes in 1910 and 1911.

I have approximately 7,000 more stumps on this property, all of which will be removed as quickly as possible, and it will be dynamite for me all the time, as I find its use easily one-half cheaper than it was possible to do this work with a team and stump puller.

We had a stump puller but sold it as we found that dynamite did the work easier, cheaper, and quicker and the results were better.

IRWIN J. DREWS,
Hillman, Minn.

Stump Puller Discarded for Red Cross Dynamite

During December, 1911, I used 40 per cent. Red Cross Dynamite for clearing white oak stumps ranging from two to three feet in diameter.

This work, labor and all, cost about 15 cents per stump or an average of $36.60 per acre as compared with a cost of at least 35 cents per stump or $84 per acre by using a stump puller. Another thing, the land was practically worthless, but after clearing it is valued at $90 per acre.

There is no other method which can be compared with dynamite. I have a horse stump puller and yet I use dynamite in preference to the puller.

GEO. L. FISCUS, Egg Harbor, N. J.

Dynamite Cheaper Than a Donkey Engine

There was a piece of land on my property which I wished to clear. During the first week in March I moved about forty fir and cedar stumps with Red Cross (low freezing) Dynamite, 40 per cent.

This work cost me about $1 per stump, a total of $40. The stumps ranged from one-and-a-half to three feet in diameter, and would have cost $2.50 per stump or a total of $100, taken out by any other method.

I have quite a number of stumps to move this fall, averaging about three feet in diameter, and will certainly use Red Cross Dynamite.

There was a donkey engine working on my neighbor's place, but I beat it with my dynamite.

BURT P. WEISE, Carrolton, Wash.

Finds Stumps an Expensive Luxury

I removed ten acres of stumps last spring from a field that I put in corn, and six acres in the fall, which were put in wheat. I have made up my mind never to farm around stumps in the future, but to take them out with dynamite. If your readers think my judgment is not good I only ask them to give it a fair trial. I thought like a great many others that it was too expensive, but if you count loss of land where the stumps stand, loss of time in working around them, chances of spoiling young horses, causing sore shoulders, breakage of machinery, worry and inconvenience of the man who does the work, you will find it economical rather than expensive.

HOMER C. SMALL, Martinsburg, W. Va.

Red Cross Removes 10,000 Stumps; Trebles Land Value

During the last four years I have blasted about 10,000 pine, poplar, elm, oak, and spruce stumps, ranging from 10 inches to 4 feet in size, on all of which 40 per cent. Red Cross Dynamite was used.

I cleared about 100 acres at a cost of about 9½ cents per stump, or $10 per acre and feel very certain that by any other method this work would have cost at least 25 cents per stump or $25 per acre.

Before removing these stumps this land was worth about $16 per acre, but today each acre is worth $60. It has been planted to corn and potatoes, and I invariably get better crops off the land cleared with dynamite than off other land not so cleared. I also secured a better stand on spots from which the stumps have been blasted than from other portions. In fact, I feel that the use of Red Cross Dynamite has enabled me to blast and burn the stumps cheaper than I could remove the same stumps after they were pulled. Red Cross Dynamite will be used exclusively on the 200 acres that I am going to clear next year.

I have a neighbor who had a "Smith" grubber. Last summer he worked in a twelve-acre field six weeks with two men and one team. They cleared about nine acres and the stumps are still on the edge of the field. About the same time, in an adjoining field, I blasted and burned every stump on fifteen acres in seven weeks, and did it alone.

C. E. SAUNDERS, Bergville, Minn.

Red Cross Cleared Land Increased in Value 400%

During 1909 I cleared twelve acres of new ground of gum, hickory, white and red oak stumps, ranging from twelve to thirty-six inches in size.

On this work I used 40 per cent. Red Cross Extra Dynamite and while the very cheapest figure at which I could have cleared this land by any other method would have been from 50 cents to 75 cents per stump or $25 per acre, Red Cross Dynamite did the work at about 20 cents per stump or $10 per acre.

In addition to the above, the land increased in value from $25 to $100 per acre. It was planted to alfalfa during 1909 and produced a much better crop than the adjoining land on which no dynamite had been used. I noticed also that it grew very luxuriantly on spots from which stumps had been removed.

As fast as I would blow the stumps out, I would have them loaded on wagons and sold for $1.50 per load. They were blown in such pieces as to make them very fine for fireplace wood, not needing any more splitting and the people in the neighborhood were very eager for them.

I regard the dynamite method a very fine way to clear land of stumps and take pleasure in stating that I was well pleased with results obtained. After deducting the amount received for the wood, it will bring the expense down to a very small item per stump and I shall certainly use Red Cross Dynamite on the other twelve-acre plot which I will clear sometime this year.

H. A. BEATTIE, Starkville, Miss.

Used a Ton of Dynamite a Week

It is only fair for me to report the success that I am having with dynamite as an agent in blowing stumps on my 100-acre tract of woodland at Beartown, Lancaster County.

I am using a ton of dynamite a week in this work and with the capable force that I now have the results are marvelous. Great chestnut and oak stumps succumb to the dynamite as easily as lifting a match. The benefit derived from this method is incalculable as it practically loosens the earth or subsoil from stump and is making plowing very easy. I have a stump puller on this tract, but it cannot be compared with dynamite as it pulls out stumps leaving roots, and I cannot possibly clear over a quarter of an acre a week with it.

Anyone is welcome to come and see the results. I have a large picture taken showing the tract clear, which the photographer will no doubt let you have if you care to use it.

I thank you for the help that your company has displayed in furthering my work.

FRANK S. BARR, Lancaster, Pa.

Advantages of Mudcapping Boulders

Extract from report of demonstration at Grand Rapids, Minn., July 18, 1911:

"This work was new to Mr. A. J. McGuire, Superintendent of the N. E. Experimental Farm, and he was amazed to see large boulders which two and three teams could not handle broken up in pieces so small that they could be lifted into a wagon by one man. He had been in the habit of drilling holes twelve inches deep in the large rock and splitting them with 40 per cent. dynamite, which split the rocks but did not break them up small.

"The rocks were all granite and some of them presented round smooth surfaces on which to place the dynamite and others had good shoulders against which to place the dynamite. In the latter case a saving of two-third pounds of dynamite was effected on large rocks. Mr. McGuire emphatically stated that he would mudcap large rocks in future and expend his surplus energy in some other directions rather than drilling granite."

After Using Red Cross Dynamite Would Not Sell Land for $100.00 per Acre Which Was Not Worth $5.00 Before

I follow agricultural blasting among the farmers of this section, and have used a great amount of dynamite in this work.

In stump blasting I have used dynamite on all kinds and all sizes of stumps in cultivated and uncultivated fields, and my experience has been that it is not only quicker and more satisfactory than any other method but it is cheaper by two-thirds.

As to boulder blasting probably the following experience may be of some interest to you:

In 1904 one of my neighbors bought a farm of about 108 acres. There was one field of about twenty-five acres that had never been cleared up, and boulders lay so thick that I have crossed the entire twenty-five acres without stepping on the ground. They ranged in sizes from one-half ton to twenty tons, and many of them weighing from five to eight tons were imbedded in the ground so that I could see nothing but the top.

I contracted with Mr. Buechner to break up all the boulders on this twenty-five acres in shape to draw. I used four boxes of 40 per cent. Extra Red Cross (low freezing) Dynamite, which, together with my labor charge, cost him $78 to get all these boulders ready for a team.

Before I started to work on this land it was absolutely worthless, but since then I have seen sixty-two bushels of wheat to the acre grow on that field, also fifty-two bushels of oats per acre and 140 bushels of corn. Furthermore, Mr. Buechner has since refused about three times the price that this farm cost him, and it was nothing but Red Cross Dynamite that put it in shape.

R. T. VAN DUSEN, Manlius, N. Y.

It is all quite true what Mr. Van Dusen stated. The land was not worth $5 before, but is as good now as any in the neighborhood. I would not sell it for less than $100 per acre.

GODFREY BUECHNER, Manlius, N. Y.

Breaking Boulders

I have had excellent results in removing boulders and breaking them up with mudcaps. In Massachusetts, many boulders of granite formation, known as "hardheads" are found. They are usually round and smooth and frequently the larger portion of them is buried in the ground. They are regarded as a hard proposition by experienced blasters. If only a part of the boulder shows above the surface, I sound with a three-eighth inch steel rod five feet long with a sharp point and poker handle, to determine the size and position of the stone underground. I then place a relatively small charge of dynamite under one end or one side, the discharge of which rolls the boulder out upon the surface of the ground. It then takes a small charge of dynamite to completely shatter it. I frequently dispose of the pieces by placing them back in the hole, thus saving the expense of carting them away. There is usually room in the hole for all of the pieces and still allow for eighteen inches of top soil over them.

WINTHROP FILLEBROWN, Bryantville, Mass.

Largest Boulders Successfully Blasted

I am sending you a photograph of a rock which weighed between six and eight tons. As shown by the picture one man could handle any piece of it after the blast. The farmer for whom this blasting was done had spent for labor from $50 to $60 in clearing five or six acres of small boulders. I cleared about as much for $8 by using Red Cross Dynamite.

W. H. NANGLE, Thorndale, Texas.

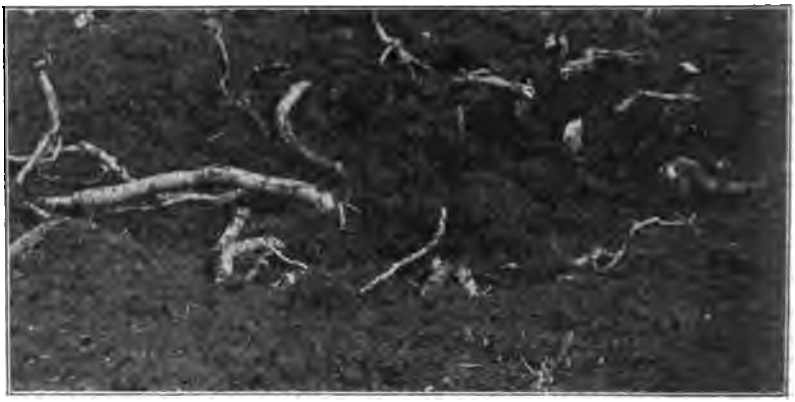


FIG. 14.—SHOWING HOW BLAST BRINGS OUT ROOTS

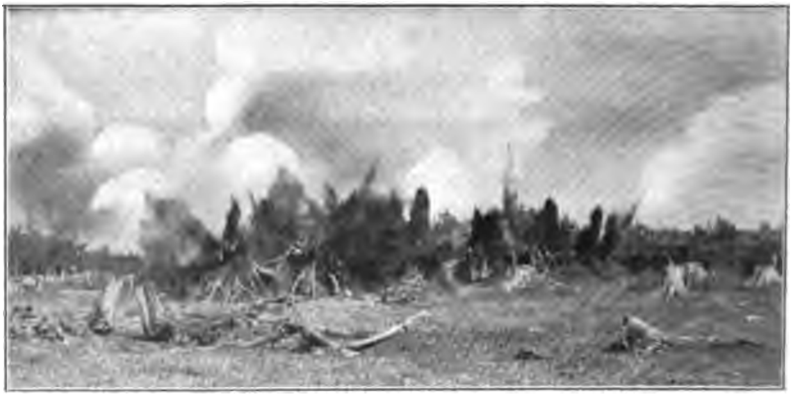


FIG. 15.—GROUP BLAST WITH BLASTING MACHINE, BARKSDALE, WIS.

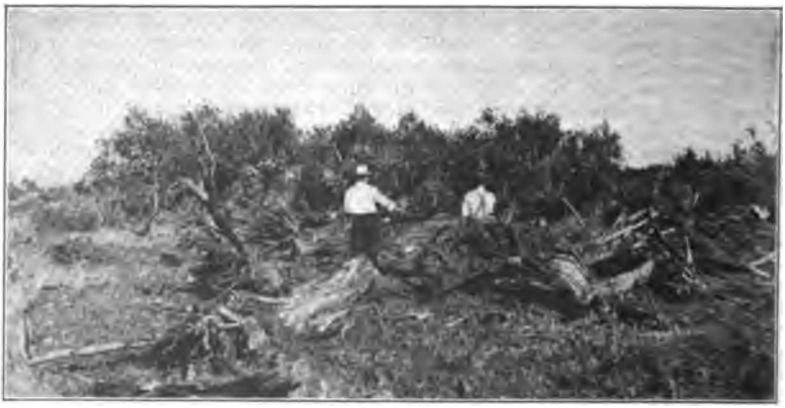


FIG. 16.—AFTER THE BLAST, BARKSDALE, WIS.

Red Cross Dynamite in the Turpentine Industry

What It Means to Owners of Cut-over Land and Turpentine Manufacturers

The manufacture of turpentine and rosin is a very important industry in seven of our Southern States. In 1909 there were 1,585 establishments engaged in manufacturing these products. The capital invested in the business was $12,375,000 and 41,959 officials and workmen were employed in the industry.

There were produced 555,000 casks of turpentine, valued at $17,680,000 and 1,906,000 barrels of rosin, valued at $18,255,000, in the year 1910.

Although it is a well-known fact that the stump contains a larger proportion of the material from which turpentine, rosin, tar, wood oil, creosote, etc., are obtained, than is contained in the trunk and branches of the tree, nevertheless until lately only the trunk and branches have been utilized by many manufacturers due to the excessive cost of getting the stump out of the ground and breaking it up into sizes that would go into the "hogs." Lately, however, the National Turpentine Company, of Georgia, has done some experimental work with excellent results. These experiments are of as much interest to owners of cut-over land in the vicinity of turpentine manufactories as to the turpentine manufacturers themselves.

In the course of making these experiments the National Company started using stump pullers, which required in themselves a rather heavy investment of capital, and to properly use which they were compelled to employ large crews of men and teams of horses, making the cost excessively high. Later, it was suggested to them that dynamite could do this work much more efficiently and economically. The experiment was tried and Mr. T. B. Gautier, President of the Company, made the following report:

"When measured, the stump wood amounted to seventeen cords. The total cost of explosives and labor was $50.59, or an average of about $3.00 per cord. These seventeen cords treated yielded eight gallons more of turpentine per cord, thirty pounds more of rosin and twenty gallons more of tar than ordinary wood. I am very much pleased with these results and expect to use dynamite for this purpose hereafter. I certify that the attached report is correct."

Labor Cost

Boring holes, 1 man 7¼ days at $1.25	$9.06¼	
Chopping roots, etc., 1 man 28½ hours at 15 cents per hour	4.27½	
Piling and loading, 1 man 2¾ days at $1.25	3.43¾	
Piling and loading, 1 man 2½ days at $1.25	2.81¼	
Helper on ox team, 1 man 2 days at $1.25	2.50	
Ox team and driver, 1½ days at $3.00	4.50	
Extra help loading cars, 2 men ¼ day at $1.25	.63	
Total labor		$27.22

Explosives

304½ cartridges dynamite	$19.87	
400 ft. fuse at 50c. per hundred	2.00	
200 caps at 75c. per hundred	1.50	
Total Explosives		$23.37
Total Cost		$50.59
154 stumps were blasted; 17 cords produced; cost per cord		3.00

One cord stump wood produced 8 gallons more turpentine, 30 pounds more rosin and 20 gallons more tar than one cord of tree wood.

Value of this increase:

8 gals. Turpentine at 26c. per gal	$2.08
30 lbs. Rosin at 1½c. per lb	.45
20 gals. Tar at 12c. per gal	2.40
	$4.93

Giving a net profit of $1.93 in favor of stump wood.

The blaster who conducted these experiments for the Turpentine Company reports that the Turpentine Manufacturers are very much pleased with the results and that land owners are now figuring on using dynamite for removing stumps from their properties and selling them to the Turpentine Company for $3.00 per cord, because that is what the Company is willing to pay for pine stump wood.

It is an admitted fact that land which has been covered with pine forests is very rich in plant foods and will yield bounteous crops if utilized for farms or orchards. The drawback heretofore has been to get the land cleared of stumps. The lumber companies have already cut the marketable timber. Some of the cut-over lands are still the property of the lumber companies. Many thousands of acres, however, have been sold at low prices to settlers who have been laboriously clearing it by digging, grubbing and burning a little at a time as they have leisure to devote to it.

These cut-over lands can now be cleared up rapidly at no actual expense to the settlers and lumber companies for they will be able to sell the stumps to the Turpentine Companies at a price that will, at least, fully cover the cost of the dynamite and labor used in the clearing work.

Apart from the far-reaching importance which this has to the agricultural development of these seven Southern States, it is of greater magnitude to the poor settler, who will now be able to clear his lands and get them into shape for the production of large and profitable crops. Lumber companies still owning cut-over pine lands can now clear them and sell them as cleared land for at least double the price they can secure for them as stump encumbered land. In short, by clearing the land, they double its value at no expense to themselves, because the cost of the clearing is more than paid for by the money received for turpentine from the stump.

Value of Products Obtained From Dynamited Pine Stumps Exceeds Value Obtained From Tree Wood

We obtained nine cords of wood from seventy-five stumps at a total cost of approximately $3.10 per cord delivered at our plant. This included a haul of about half a mile.

The value of the product obtained from this wood exceeded the value obtained from the tree wood. We have a crew at work shooting stumps now and expect to start another crew next week. From present appearances we will use larger quantities of Red Cross Dynamite in the near future.

ATLANTIC TURPENTINE & REFINING CO.,
E. B. Smith, Gen. Supt.,
Savannah, Ga.

Pine Stumps Blasted Out, Split and Ready for the "Hogs" at $2.66 per Cord

As to the cost of producing stump wood for our plant with dynamite.

The cost of the first sixteen cords was approximately $2.66 per cord for shooting out the stumps, chopping them to suitable size for our purpose and piling them ready for the wagons.

We have gotten out several car loads of stump wood at prices varying from $2.61 to $2.98 per cord.

We have recently made our first run of stump wood with very satisfactory results.

Today we are ordering our second shipment of explosives and expect to use large quantities of dynamite in the future.

STANDARD TURPENTINE COMPANY,
Per Frank L. Fogarty, Acting Assistant Treasurer.

The foregoing clearly proves the advantages of clearing land with dynamite instead of by any other means, and the following is a condensed outline of the benefits derived by doing this work.

The stump-covered site of a former piece of woods is, as you know, new, rich soil that needs no fertilizer.

You also know that pulling stumps with a machine is the hardest kind of work—liable to seriously injure yourself or your horses, and certain to require a lot of work to get rid of the stump after pulling.

Then, too, it leaves the field full of holes, that must be filled; and plowing the hard, packed soil around old roots is no joke.

If instead of pulling the stumps you burn them out, the intense heat required destroys the humus in the soil all around the fire and you will have a burned field requiring a good deal of cultivating instead of new fertile soil.

You can dynamite all those stumps for about one-third the cost of pulling and chopping them up.

The blast splits up the stump into firewood, removes all the dirt, breaks all the main roots, and loosens the soil for yards around.

You can blast fifty stumps in the time it would take to pull and chop up one or two.

One man can do all the work, if necessary.

After the stumps are all blasted out, you will have a new, rich field, easy to cultivate, and which will yield bumper crops.

If you want to remove a whole tree, Red Cross Dynamite will lift it bodily out of the ground, and it will usually fall with the wind. When this is done, there is no stump to remove.

The split stumps can be removed easily to one place, burned, and the ashes saved for spreading on the land or for leaching.

If whole stumps are preferred for making fences, they may be blown out whole by regulating the charges.

Boulders, which you are now obliged to plow around, can be broken up into easily-handled blocks by a single blast.

Red Cross Dynamite not only removes your stumps and boulders but at the same time subsoils your land. The action of the explosion is such as to loosen and shake up the subsoil for a considerable distance around, the blast thereby rendering the land porous and mellow. It is an easy matter to pick out, after crops are grown, the various places where stumps have been blasted because of the great difference in yield as compared with the rest of the field.

All of the foregoing claims are conclusively *proven* by the letters of disinterested parties, who have tried our methods, which are quoted in this booklet. Follow their advice; take advantage of their experience; join the Red Cross Army and be the happy, prosperous owner of a productive, sightly farm.

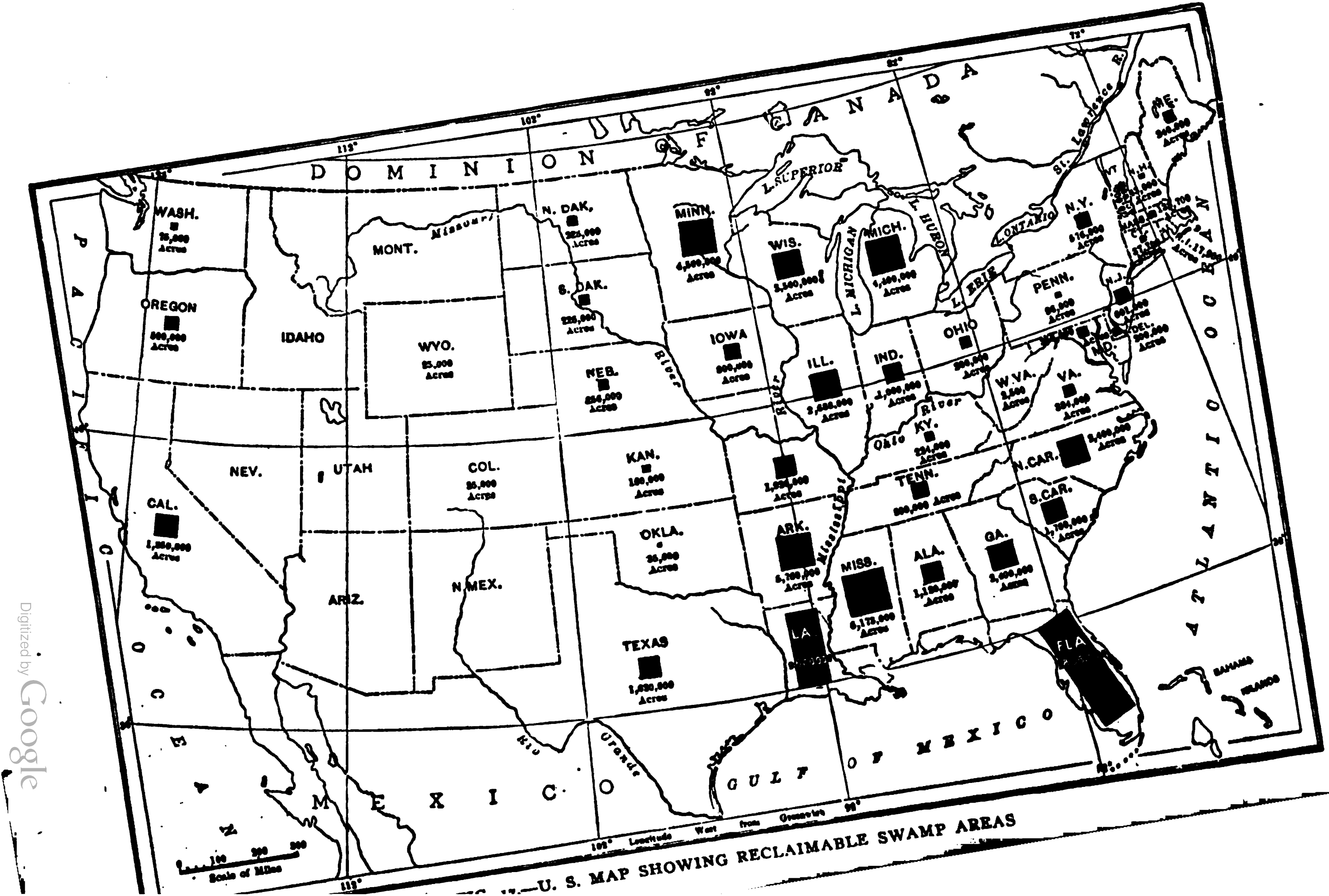


FIG. 17.—U. S. MAP SHOWING RECLAIMABLE SWAMP AREAS

DITCHING

AND

DRAINAGE

WITH

RED CROSS DYNAMITE

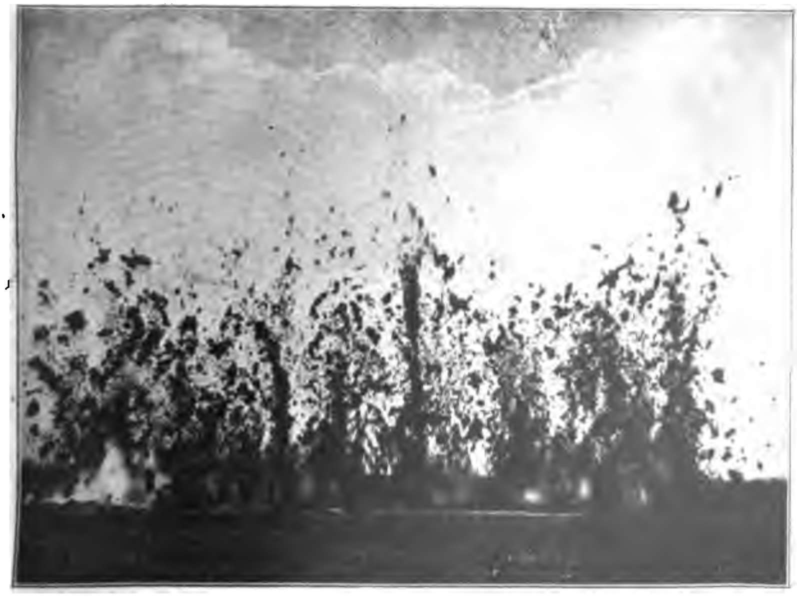


FIG. 18.—110 FOOT DITCH BLAST, ELK GROVE, SACRAMENTO CO., CALIF.

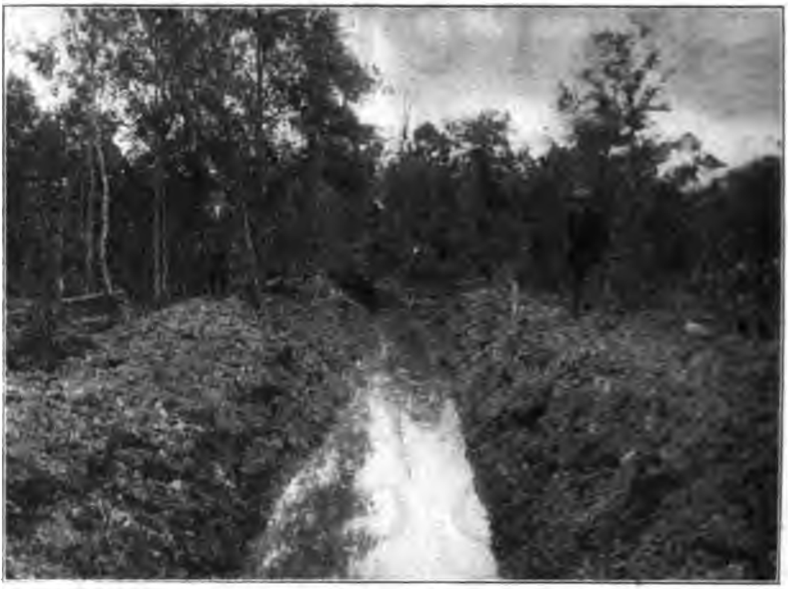


FIG. 19.—GOVERNMENT EXPERIMENT IN BLASTING DITCHES, CHARLESTON, S. C.

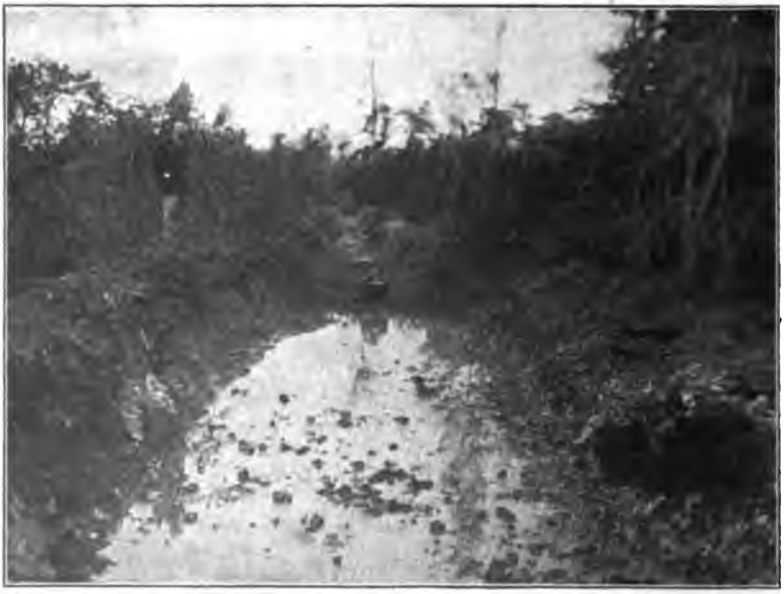


FIG. 20.—ANOTHER DITCH. SAME EXPERIMENT

Reclamation by Drainage

The First National Drainage Congress met in Chicago December 9, 1911. Among the facts presented were the following:

That there are in the United States more than 75,000,000 acres of swamp land that are non-productive.

That the drainage of this land will reclaim it for agricultural pursuits and add several billions of dollars to the wealth of the nation.

The location of these reclaimable swamp lands and their approximate areas are shown in the table below:

	ACRES.
Alabama	1,120,000
Arkansas	5,760,000
California	1,850,000
Connecticut	37,700
Delaware	200,000
Florida	18,500,000
Georgia	2,400,000
Illinois	2,688,000
Indiana	1,000,000
Iowa	800,000
Kansas	160,000
Kentucky	224,000
Louisiana	9,600,000
Maine	240,000
Maryland	356,000
Massachusetts	138,700
Michigan	4,400,000
Minnesota	4,500,000
Mississippi	6,173,000
Missouri	1,920,000
Nebraska	256,000
New Hampshire	43,000
New Jersey	601,900
New York	576,000
North Carolina	2,400,000
North Dakota	226,000
Ohio	200,000
Oklahoma	35,000
Oregon	500,000
Pennsylvania	96,000
Rhode Island	17,900
South Carolina	1,760,000
South Dakota	226,000
Tennessee	800,000
Texas	1,620,000
Vermont	70,000
Virginia	384,000
Washington	75,000
West Virginia	2,500
Wisconsin	2,500,000
Wyoming	25,000
Total	74,541,700

A writer in a Southern publication gives the following interesting information regarding the swamp areas of the United States and the value of these areas if they were drained.

"The latent wealth in 10,000,000 acres of reclaimable delta and overflow lands of Louisiana is so much greater than any discovery of mineral wealth in gold deposits that was ever made that it is hard to make a comparison. If that land were reclaimed, settled and cultivated, with a settler and his family on every ten-acre farm, it would yield every year food products that could be sold for gold aggregating a thousand million dollars a year. And if it were known that along the marshes of your coasts and under the waters of your bayous there was $1,000,000,000 contained in gold deposits of some form, you would have a gold rush from every part of the world that would bring greater multitudes to your state than the gold discovery of 1849 took to California.

"There is no place in this world where such latent possibilities of agricultural wealth exist on such a stupendous scale as in Louisiana.

"This whole question of land reclamation or drainage is of enormous importance nationally. There are estimated to be 74,541,700 acres that can be reclaimed by drainage and it is scattered through forty states."

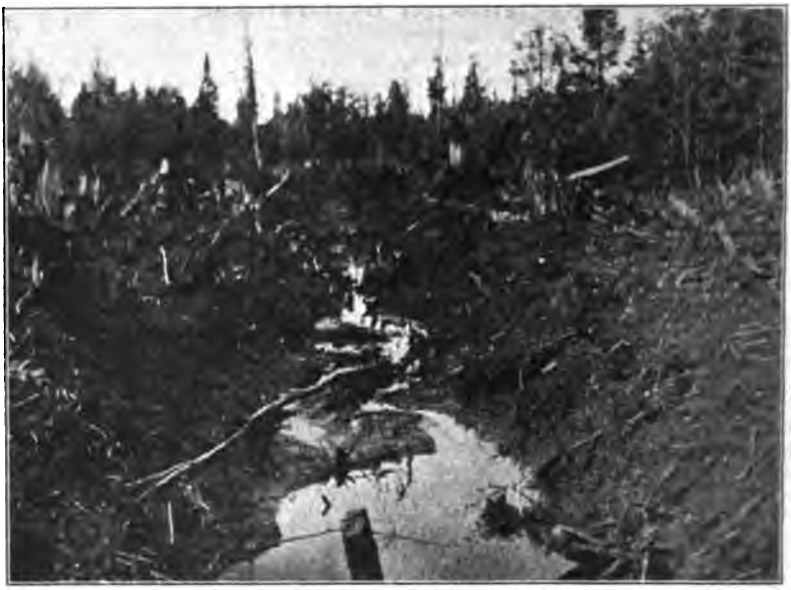


FIG. 21.—DYNAMITING DIGS DITCHES THROUGH LAND THAT CANNOT BE ECONOMICALLY HANDLED OTHERWISE

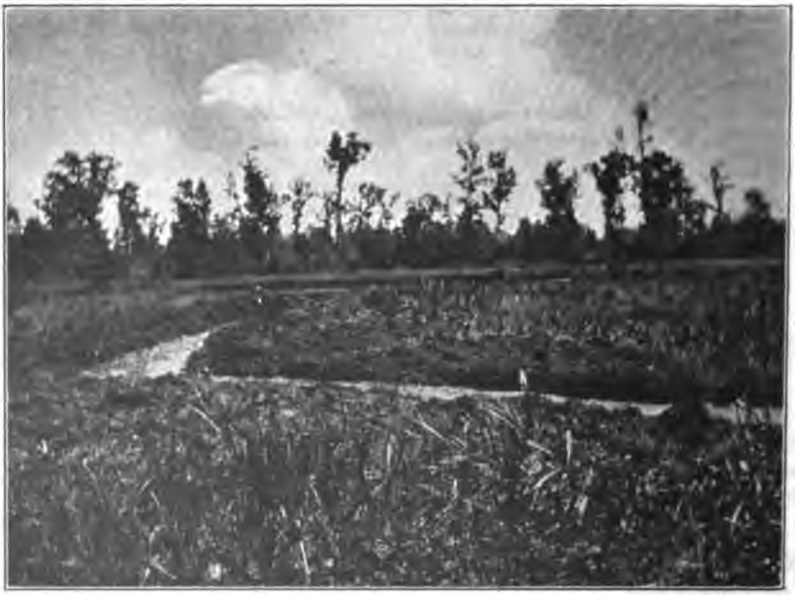


FIG. 22.—A DITCH BLASTED AROUND A CORNER IN ONE BLAST

Col. Will L. Sargent, traveling immigration agent of the joint Texas and Louisiana Immigration Bureau, is another enthusiastic believer in reclamation by the drainage process and has spent a great deal of his time studying land conditions, soil possibilities, the results of reclamation, the crops that are produced after the land has been reclaimed and every other phase of the subject.

"The reclamation, by drainage, of our wet lands will produce better health," declared Col. Sargent, "and if the 74,000,000 acres in the United States were reclaimed and divided into 40-acre farms there would be added 1,850,000 new farms. And if each farmer spent $350 per annum the purchasing power of this class of farmers alone would mean $647,500,000 that would go into the various channels of trade, etc."

Continuing further along that line, Col. Sargent said: "Estimating five persons to the family for each of the 40-acre farms, the agricultural population of the United States would be increased 5,550,000. Under intense cultivation these lands could be made to produce, at a most conservative estimate, $50 per acre, or $3,700,000,000, as an additional production of wealth which would be distributed throughout the country.

"The federal government places the cost for draining at from $2 to $30 per acre. Let us place the average cost at $25 per acre, and you will find that the total cost for reclaiming the 74,000,000 acres would amount to $1,850,000,000. Any drained project, if served by transportation, judiciously managed, will yield a much larger profit as an investment than almost any other line that is conservative that one can engage in. Besides, it is a safe investment.

"The cost of drainage, as compared with other work of improvement, is small," continued Col. Sargent. "The average cost of the reclaiming of arid and semi-arid lands for irrigation in the western part of the United States, which is done by the federal government under the Cary Act, is about $36 per acre, some projects costing as high as $100 per acre. It is a safe conclusion to say that a person can acquire at least two acres of drained land for the cost of one of irrigated lands. Besides the greater portion of the lands subject to drainage already have, or there are nearby, transportation facilities as well as settlement, which is seldom the case with irrigated projects.

"If these rich lands were drained and placed upon the market, we would not only stop the great tide of emigration from the United States to Canada, but in turn could secure many Canadians that are well-to-do, and who have become tired of that frigid climate and desire to migrate where they do not have to house their stock and themselves nine months in the year to keep from freezing, thereby consuming the most of their products made during the short-crop season."

In order to present the magnitude of the swamp areas of this country, it is simply necessary for us to state that it equals about one-sixth of the entire cultivated areas of the country.

These swamp lands are exceedingly rich in humus and valuable plant foods. When drained and prepared for cultivation, they will produce larger crops than any other existing soils.

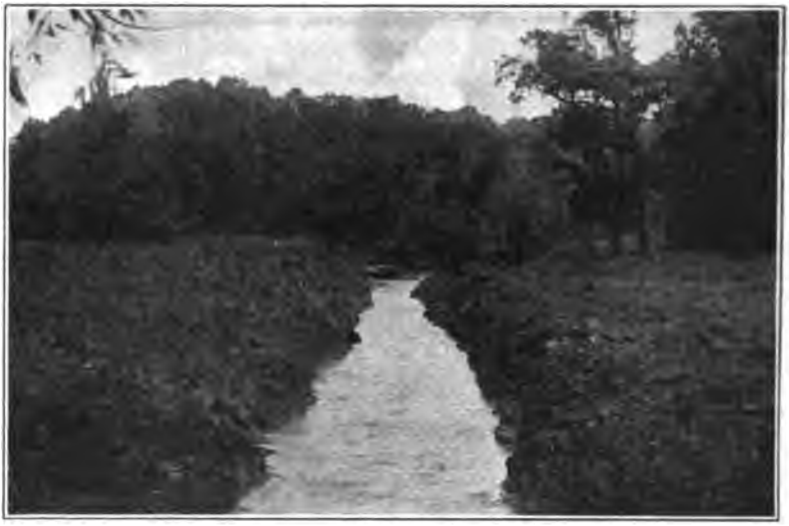


FIG. 23.—DITCH BLASTED AT WESTCHESTER, PA., TO CHANGE COURSE OF STREAM

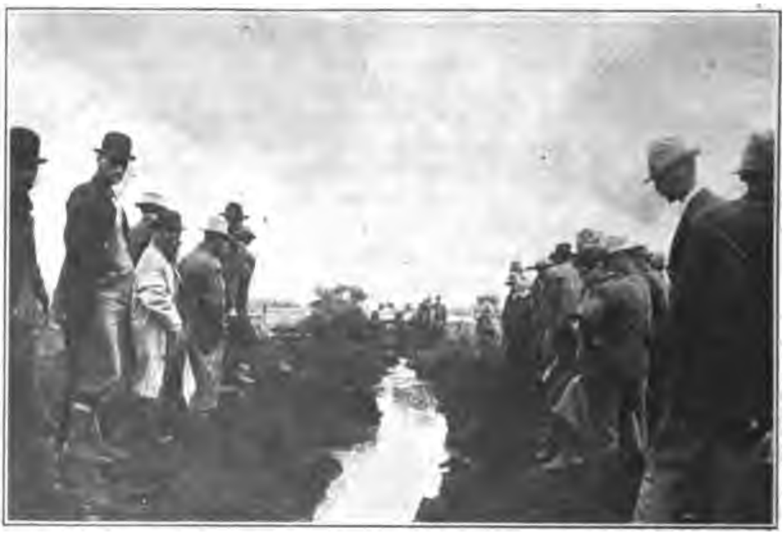


FIG. 24.—DITCH BLASTED IN HEAVY SOIL AT ALBANY, ORE.

Advantages of Red Cross Dynamite for Ditching

Farmers have been using Red Cross Dynamite for draining swamps and wet fields for many years, and much valuable farm land has been reclaimed and made available for cropping by so doing. The cost of the work and of the explosives is very small compared with the value of the land reclaimed.

The draining is accomplished in one of two ways, depending upon conditions. Sometimes it is better to drain wet land by ditching, while at other times it is more practicable to permit the water to escape by a process of seepage through the soil.

It is not always possible to drain by ditching. Whether it can be done in that way depends upon whether the slope of the land permits. If the swampy or wet spot is low, surrounded on all sides by hills, ditching would not work. The drainage can then best be done by subsoil blasting. This is done by exploding charges of dynamite sunk deep in the ground, which breaks up the hard soil and allows the water to find an outlet through the sand and gravel beneath. Whether this is practicable, of course, depends upon the thickness of the stratum of impervious subsoil and also upon its depth beneath the surface soil.

For ditching, blasting is superior to old time pick and shovel methods in every way. One of the most difficult problems the modern farmer has to face is the securing of farm labor. Therefore, any method of doing farm work which makes possible the employment of fewer men is recognized as a good thing. To dig a big ditch quickly by manual labor requires the employment of a number of men for a considerable period of time. Where are the men to be had? Using dynamite for ditching solves the farmer's problem. One man equipped with a pointed steel bar, a sledge hammer and a supply of dynamite cartridges, fuse and blasting caps, or electric blasting machine, can excavate as much ditch in one day as many men could dig out with picks and shovels.

Blasting a ditch is a very simple matter. After making the holes the proper depth with the pointed bar or punch, the blaster places the dynamite cartridges at the bottom of the holes, and then explodes the charges. The dynamite does all the work. If soil conditions are favorable, the result is a nice, clean ditch of the required depth and width, the earth being spread evenly over the ground along the banks, and turning in the water clears away what little of the dirt may have fallen back into the trench after the blast. The cost of ditching with dynamite runs from 8c. to 12c. per cubic yard, compared with an average cost of 25c. per cubic yard when the work is done with pick and shovel.

Dynamite is not recommended for excavating large ditches having a depth greater than 6 feet, or width greater than 16 feet, but within these limits it is the quickest and usually the cheapest means for ditching.

In large reclamation projects the main canals can usually be excavated cheaper by dredging machines, but for laterals and sub-laterals Red Cross Extra Dynamite is better.

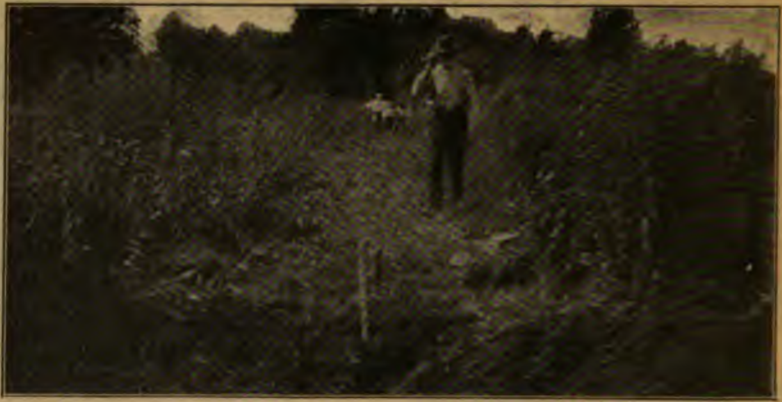


FIG. 25.—BEFORE THE BLAST, BURKETT FARM, NEWBURGH, N. Y.

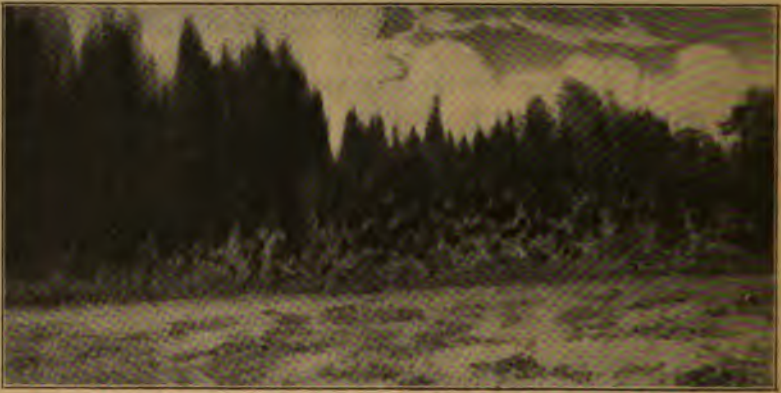


FIG. 26.—THE BLAST

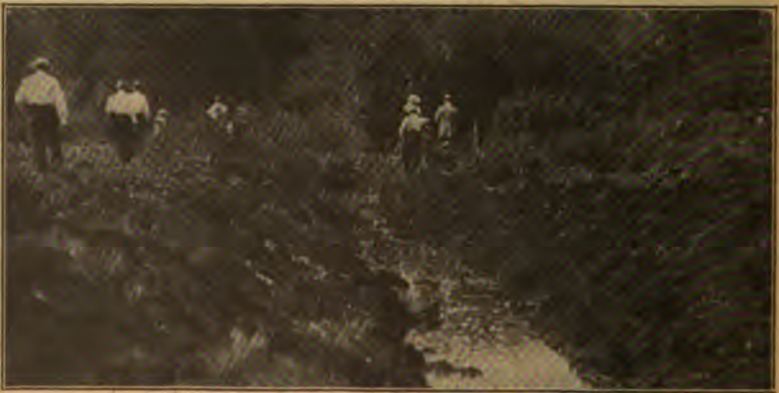


FIG. 27.—A FEW MINUTES AFTER THE BLAST

Successful Ditching on Farm of Editor of American Agriculturist

NEWBURGH, N. Y., JULY 18, 1911.

"The dynamite demonstration on my farm last week was an emphatic success. The ditching was a complete surprise to everybody. The dynamite certainly did the work and made as pretty a ditch as ever I saw. (See cuts on page 32.)

"The subsoiling work I am confident is full of promise. I shall follow all these matters very carefully from year to year and record just what results have been obtained.

"C. N. BURKETT."

A Professional Blaster's Report of Some Drainage Blasts

HUTCHINSON, KAN., JANUARY 16, 1912.

E. I. DU PONT DE NEMOURS POWDER CO.
WILMINGTON, DEL.

Gentlemen:

Received your letter, have read it over carefully and would say that the Severance Farm, where I dynamited has raised in value fifty dollars per acre and also that the Wells Place three miles south of Hutchinson where I dynamited to drain ground, was just in small patches, but he got enough wheat off the blasted ground to pay for shooting his whole eighty acres.

As for Mr. Spankenberger he had a big basin in the middle of his field. I went out there last February and shot fifty pounds of Du Pont 40% Red Cross on this five acres and in one week from the day I shot this we had six inches of rainfall (in one week) and Mr. Spankenberger rode out to his field expecting to find a pond as usual, but to his surprise his ground was dry, no water standing in this basin. This was a poor corn year in this country, but Mr. Spankenberger raised corn enough on this basin to more than pay for shooting this land.

Mr. Jake Siegrist, four miles southwest of Hutchinson, had a piece of land similar to Mr. Spankenberger's and I shot fifty pounds of dynamite on it and he raised a corn crop on it this year. Also Mr. George Siegrist at Whiteside, Kan., had a piece of land on his place of five acres that was worthless. I shot thirty pounds of dvnamite on this ground one year ago and today this ground is worth seventy dollars per acre.

I went up into Pawnee County two years ago and shot a piece of ground that was under water two feet deep at the time, consisting of thirty acres. I drained the water all off that ground with twenty-five pounds of dynamite and Mr. Ford plowed this up and sowed it to alfalfa and he has got as nice a field of alfalfa now as there is in Pawnee County.

I also dynamited thirty tree holes for Mr. Friends in Rozel, Kans., and he did not lose a tree. I also dynamited thirty tree holes for Mr. Smith and every tree he planted lived but one. I dynamited thirty-one tree holes for Mr. Yaggar of Rozel, Kans., and his trees all lived, and trees don't grow in this country in an ordinary tree hole.

All of those places I have told you about I have kept personal track of and I know what they were and what they are now, besides dozens of others.

Yours truly,

A. G. CRABB,
720 E. 7th Street,
Hutchinson, Kans.

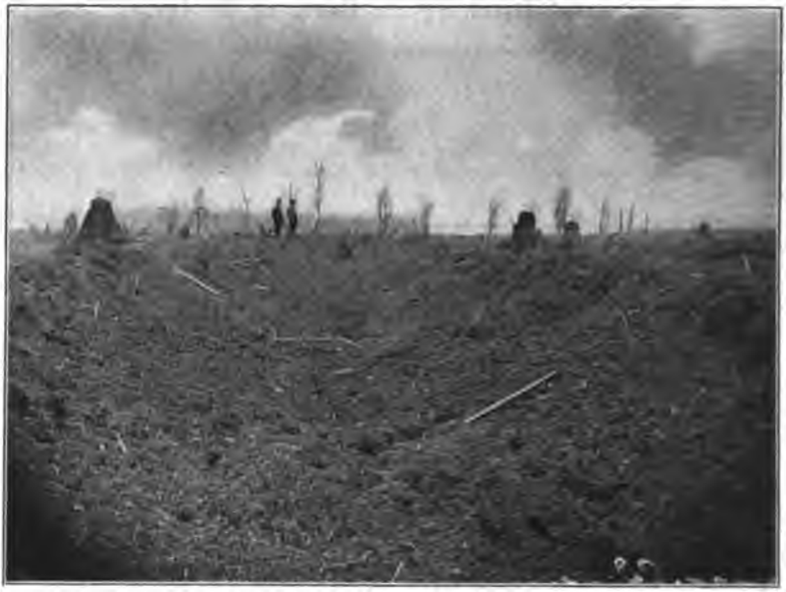


FIG. 28.—AFTER A BIG DITCH BLAST AT DIEHLSTADT, MO.

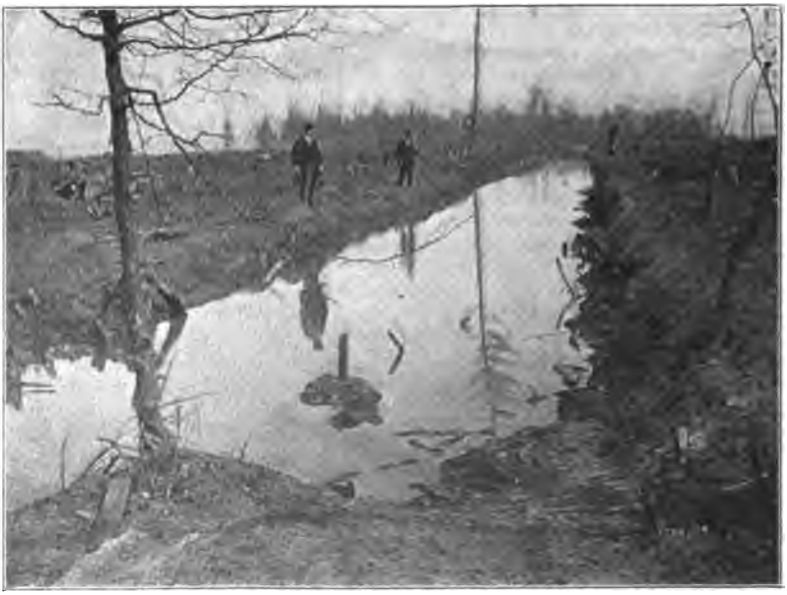


FIG. 29.—SAME DITCH AS IN UPPER VIEW, FILLED

Land Value Increased $130.00 per Acre

WHITESIDE, KANSAS, February 21, 1912.

In reference to the wet land shot for me by Mr. A. G. Crabb:

There never has been any water stand on this land since shooting. It cost me about fifteen dollars ($15.00), and I have had as good oats on it as on any of the field. This year it is in wheat, and the wheat looks better where the pond stood than on the rest of the field.

Before shooting this land was worthless, but I have since refused $130.00 per acre.

GEORGE W. SIEGRIST,
Hutchinson, Kansas.

Du Pont Dynamite Saves $435.00 for This Missouri Farmer and Increased Value of His Farm by Increased Crops

On March 10th, 1911, a large ditch was shot at Diehlstadt, Mo., on the farm of Mr. Max L. Ostner. See opposite page, showing finished ditch and water flowing through it.

The length of the ditch made was 1,720 feet. Three rows of holes, 3 feet apart each way, were drilled, the rows being staggered. The center row of holes were 3 feet 8 inches deep and the two outside rows 3 feet deep. In each of the centre holes were loaded 3 cartridges, Hercules 50%, 1¼ x 8, and in each of the outside holes 2 cartridges. It was originally planned to fire the entire 1,720 feet of ditch with one set of primer holes, i. e., two holes in each row, these holes being loaded with an extra cartridge, containing the cap and fuse. When fired 500 feet of the ditch was cleaned out, and it developed that there was a dry sand ridge in the centre of the 1,720 feet which extended about 400 feet, this preventing the entire 1,720 feet from being excavated with the one priming. A second primer group was arranged and in this shot 800 feet of ditch was made. Several extra primings were necessary to get the dry sand ridge blown out cleanly. There was about 1 foot of water in all the holes blasted with the exception of those in the dry sand ridge. The soil in the remainder of the ditch was a sandy loam with some mixture of clay.

The ditch made was 16 feet wide at the top, 8 feet wide at the bottom and averaged 4 feet in depth. It was fairly well cleaned out all along.

The total cost of the ditch was $329.00. There was moved 3,058 cubic yards of material, costing 10.76c. per cubic yard for the entire work, against 25c. per cubic yard if the ditch had been dug by pick and shovel.

The temperature at the time of demonstration was 62 degrees F., in the sun, and 49 degrees in the shade. The temperature of the water in the holes was 35 degrees Fahrenheit.

Dynamite Cuts Cost in Two

ONAMIA, MINN., Aug. 9, 1911.

In regard to ditching with dynamite will say, it's grand in wet ground. The ditch dug on my place would cost me at least 80c. per rod, and with dynamite it was less than half; and then such quick work. One minute after loading was done the water came running in like the ditch had been there all the time. I think it was fine.

Yours very truly,
PETER PETERSON.

Ten Days' Work in One Day

Relative to the demonstration of ditching work given by your company on May 16th, at Vandalia, I would advise that the result of this demonstration was highly satisfactory to all interested.

The ditch averaged 4 feet deep and 6 feet wide at the top. Owing to the fact that the work was done in dry ground it was necessary to use a battery in connection with same. This increased the cost of the work. In the manner in which the ditch was shot, tl. expense averaged $1.30 per rod. Had the ground been wet the cost would have been 90c. per rod. To have done the work with teams and scrapers would have cost us $1.50 per rod and required 10 days to complete the work that was done in one day.

Yours truly,

GEO. F. SNERLY,
District Drainage Commissioner, Fayette County, Ill.

Does Four Days' Work in Three Hours

London Grove, Pa., November 6, 1911.

I am pleased to advise that I have used Red Cross Dynamite for draining swamps on my property, reclaiming about one-eighth of an acre, which has always been unproductive. This is now pasture land.

This land was drained by ditching, and I found the use of dynamite for this work less than one-third the cost of digging by hand and then hauling away the dirt. The time consumed in ditching with dynamite required about three hours for one man, and by the old method of digging it would have taken one man at least four days. This would have left dirt on the ridge along the drain, whereas by using dynamite it was distributed evenly along the sides.

T. S. GROFF.

Uses Dynamite in Irrigation Ditching

Billings, Montana, Feb. 17, 1912.

Last spring (1911), your Mr. J. C. Horgan made four shots on my place. The idea was to loosen up the gravel and hardpan so that the water would drain from the low ground into the drain ditch which traverses my property.

Hitherto, during the irrigating season, water would stand on low areas of my ground, and it would be necessary for me to run lateral drain ditches from the main ditch to the low spots. Mr. Horgan put holes down about five feet and charged them with one and one-half pounds of Dupont Red Cross dynamite.

This summer the ground thus shot absolutely drained into the main drain and water would not stand on it, so I can recommend this system to any wishing to overcome similar conditions.

Yours truly, BILLINGS GREENHOUSE CO.,
By J. W. Partington.

Endorsed by Experiment Station

We have done some remarkably efficient ditching work at a small cost (compared to teams and pick and shovel) by using dynamite. I have in mind a piece of ditch 50 feet long, 6 feet wide, and 3 feet deep, which was dug at a cost of 12¾ cents per cubic yard. An argument that greatly favors using dynamite in this particular kind of work is that no water holding banks are thrown up, resulting in almost perfect surface drainage. Another feature greatly in favor of using dynamite in ditching is the rapidity in which it can be done. When the ground is wet and heavy, and farming operations are at an enforced standstill, then is the time to do the best work in ditching—*with dynamite.*

PAUL D. PERKINS,
Supt. Angleton Station,
Texas Agricultural Experiment Stations.

8000 Acres Reclaimed by Ditching

HERNANDO, MISS., Jan. 15, 1912.

Your letter received this A. M. in regard to the use of explosives. I have had a very remarkable success in this line, especially in blasting stumps, ditches and hardpan.

There was a large drainage district in this county, called Hurricane Swamp Land District, comprising about eight thousand (8,000) acres of land not susceptible to cultivation. Bonds were issued to the amount of $10,000 for a ditch 8 feet wide and from 2½ to 10 feet deep. My father was interested in several thousand acres of land in this district, so he bought the bonds and carried out the contract of excavating the canal.

I was put in charge of the above work and completed the canal, using over two thousand ($2,000) dollars worth of Red Cross Dynamite bought from Levi Joy & Company, of Memphis, Tenn. I started this work, removing the stumps with a stump puller, but found I had struck a hard proposition. My first order for one thousand (1,000) pounds of 40% dynamite made the stumps come so easy that I thought blasting the ditch was possible, so I began and in a few days could remove more dirt for $1.50 invested in dynamite than $3.00 of shovel work. I made average of handling dirt at 11½c. per cubic yard where it would have cost me 20c. to shovel same. Where the cut was more than 6 ft. negroes would not attempt to use the shovel but wanted barrows. So here is where Mr. Negro lost out, as the dynamite blew it out most successfully.

The above canal was in made land from 4 to 10 feet deep and required considerable boring to get under some of the largest stumps, but after the explosion I had no bother with pulling the remains off right of way. In using the stump puller it was more trouble to remove the stumps after being pulled as the dirt remaining on some of the stumps would weigh tons and had to be loosened and knocked off with the use of two (2) sticks of dynamite. When using dynamite a man could roll it off with little trouble right away, and without the dynamite he could have hardly pulled it off with eight yoke of cattle.

This land that was worthless is now the finest land in the county. I have used the 40% dynamite in all of my work and we attribute the fast coming and washing due to the use of your explosives. I hope to dynamite about 15 acres of my own farm between now and the 15th of March. The above work will be subsoiling as we have a very heavy clay subsoil in this district. I thoroughly understand setting trees with dynamite and all its branches.

Yours very truly,

N. C. BANKS,
Box 14, Hernando, Miss.

Straightens Creek With Dynamite

YALMAR, MICH., Sept. 21, 1911.

The ditching proposition hit me the most and would never believe until I saw your men do it here, as the creek was making all kinds of turns and swings and cutting my farm up in an awful shape, and I could have had it done long before this if I had only known how, and with a great deal less labor and at half cost than to do it with a team and scraper. Even then it would have been very hard to get it done on account of all the roots and big stones there are in places which were easily shot out with dynamite.

The ditch they shot here to my measure was 80 feet long and 7 feet wide and 3½ at bottom, 3½ feet to 4 deep with the cost of $2.25, which would cost me close to $1.25 per rod if I was to have it done with team and scraper or with a shovel.

CHAS. WILSON.

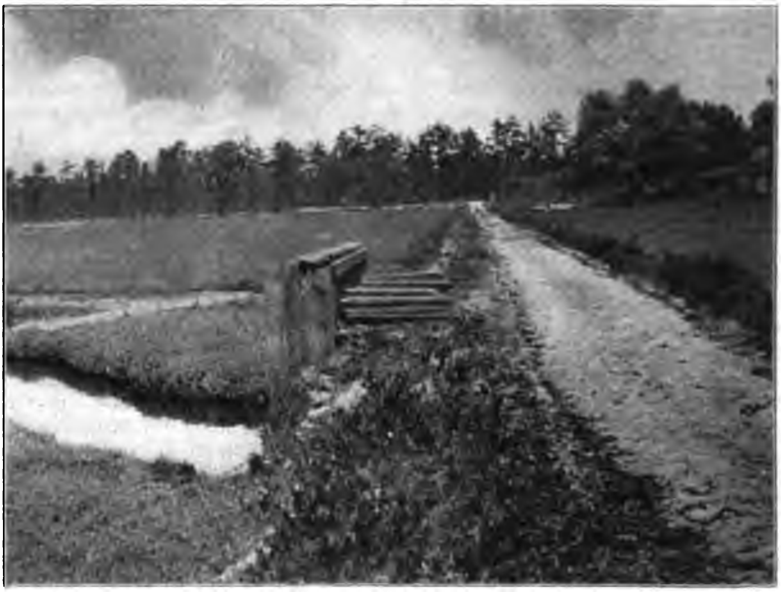


FIG. 30.—DITCH BLASTED WITH DYNAMITE. RIDER CRANBERRY BOGS, HAMMONTON, N. J.

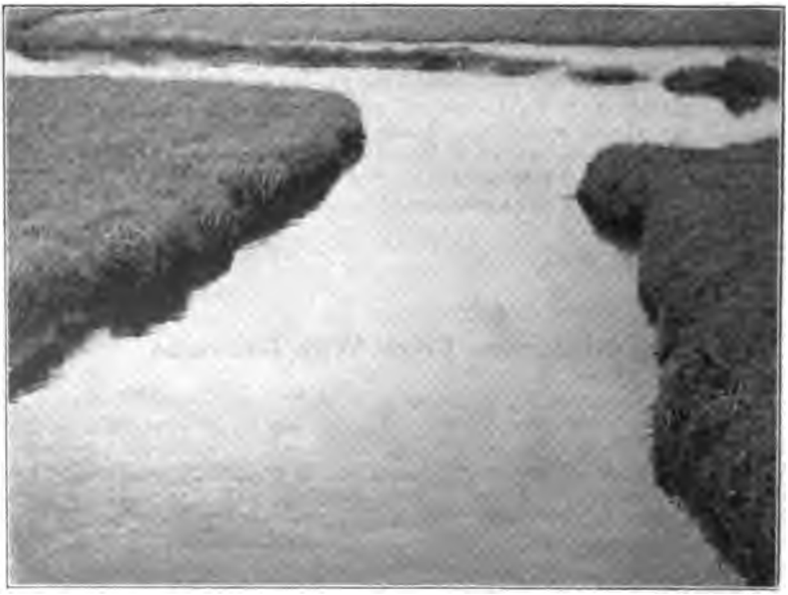


FIG. 31.—ANOTHER DYNAMITED DITCH ON RIDER BOGS

Ditching Cranberry Bogs

This class of ditching differs from the ordinary because what is required is not merely a means of removing surplus water from land, but also a means of flooding the same land several times a year.

The sort of land best adapted for cranberry culture is ideal for ditching with dynamite because wet and heavy.

The method used is by propagated blast from a central detonator, no blasting machine or electric fuzes being required.

The letter printed below is from one of the country's leading cranberry growers and a pioneer in the use of dynamite for ditching, he having successfully used it for twenty years. At the 1911 annual meeting of the American Cranberry Growers Association, Mr. Rider stated he had never experienced any casualties in using dynamite and considered it safer to handle than gasoline.

Note his statement regarding effect of blasting on fungus. This bears out similar experiences of orchardists.

Dynamite Successfully Used for Twenty Years in Cranberry Growing

Mr. A. J. Rider, Secretary of the American Cranberry Growers' Association, of Hammonton, N. J., writes:

I have used dynamite in the development of my cranberry enterprises with success and economy for the past twenty years. In removing obstructions from water courses, opening ditches and preparing the way for dams and flood-gates, it is especially useful. I keep a supply on hand at all times, and my foremen are all instructed in its use. The saving in time and labor thus effected is very great.

Dynamite will make a straight ditch and under conditions with which nothing but a dredging machine could cope. In excavating for flood-gates the mud walls are temporarily packed so solidly that water hardly seeps through. A crowbar and a stick of dynamite will stop a leak in a dam that would otherwise require hours, and possibly days of labor. All cranberry plants are susceptible to fungus diseases, and much experimenting has been done by growers and government experts to control this enemy. Without being able to give scientific reasons I owe it to dynamite that there has never been fungus growth at Hampton, one of my largest plantations, where I have used it freely.

If the advantages to be obtained through the use of dynamite were brought to the attention of all large cranberry growers I believe you would be doing them a great service.

Very truly yours, A. J. RIDER.

Ditching With Dynamite Costs ¼ Ordinary Method

St. Louis, Mo., February 8, 1912.

We take pleasure in advising you that in the month of November, 1911, we dug a ditch with dynamite—about 500 yards long, 10 feet wide and 4 feet deep. The result was very satisfactory and gratifying, and the cost was not much more than one-fourth of digging the ditch by ordinary methods.

If you have any prospective patrons in this section of the country, will take great pleasure in giving them the facts, and if they care to, showing them the result of the ditching done by us.

Very truly yours,
ISLAND REALTY AND INVESTMENT CO.

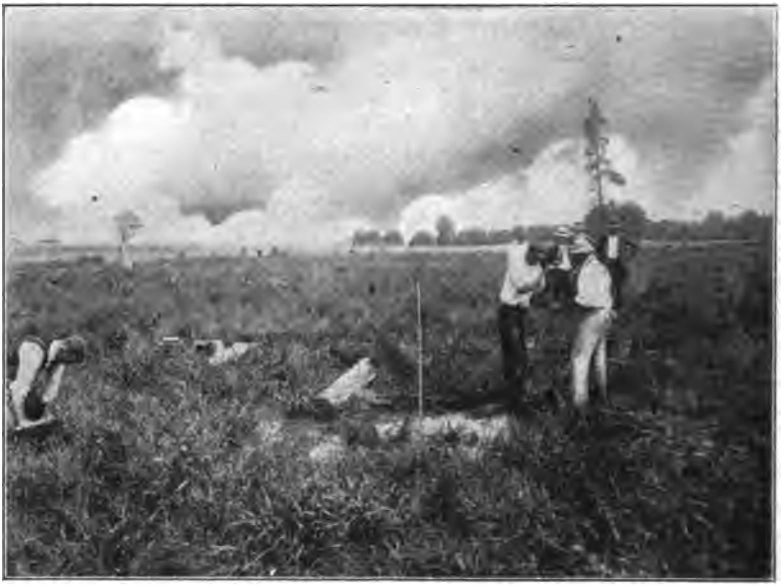


FIG. 32.—PLACING CHARGE FOR DRAINING POND AT NEWARK, DEL.

FIG. 33.—A FEW MINUTES AFTER THE BLAST OF POND

Draining Frog Ponds or Wet Spots

Swamps and ponds, except where they are close to rivers, lakes or the ocean, are caused by spring or surface water collecting on low ground without a lower outlet and which is underlaid by clay or other subsoil that the water cannot sink through. When it is not practicable to drain these swamps by ditching they can often be permanently dried up by shattering the impervious subsoil in the lowest places with dynamite.

Former Pond Yields $75 per Acre Crop

UNITED STATES DEPARTMENT OF AGRICULTURE.
BUREAU OF PLANT INDUSTRY,
Washington, D. C.
Office of Farmers' Co-operative Demonstration Work.

Morrillton, Ark., Jan. 18, 1912.

E. I. du Pont de Nemours Powder Co.
Wilmington, Del.

Gentlemen:

As per your request, I here give you my experience with dynamite as a water sinker in my field in Georgia.

I had a lime sink in my field and the water would collect in that basin and would cover about one acre and a half of ground, so some years when we had excessive rainfall I could not plant it to anything.

My brother came to see me on a visit and he said: "Why don't you put down a hole 25 or 35 feet and shoot it with dynamite and sink the water?" So I put down a hole 23 ft. and shot it, and it sunk the water.

I weighed the corn that I gathered from the 1½ acres the first year and I got a few pounds more than 100 bushels of just as good corn as I have made in my life. This made more than $75.00, whereas I had been getting nothing from this land, besides it was very disagreeable to have to work around this wet spot each year.

That was the only year I gathered the corn separately, although it seemed to be better every year I cultivated it until I sold the farm, and I do know that the land worked better every year. This experience of mine, and the results which I secured is what makes me recommend subsoiling with dynamite so strongly. Yours very truly,

JOHN W. PARLIN, Special Agent.

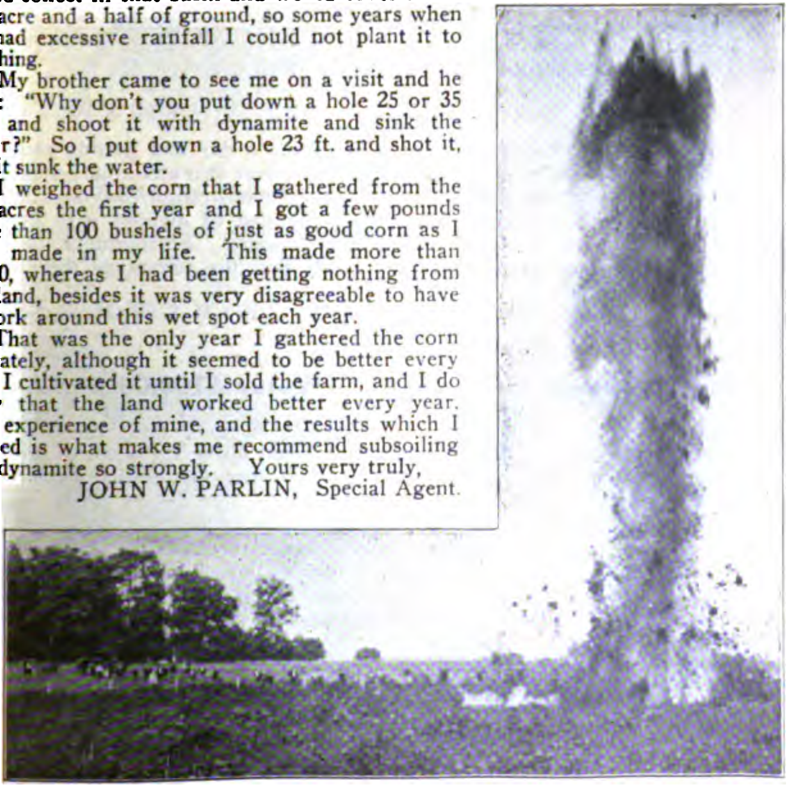


FIG 34
BLASTING THE POND SHOWN ON OPPOSITE PAGE

Ditching With Dynamite Endorsed by High Authority

UPPER PENINSULA STATION
Leo M. Geismar, Supt.
MICHIGAN EXPERIMENT STATION

CHATHAM, MICH., March 11, 1912.

I have used many tons of dynamite within the past twenty years, both in removing stumps and for breaking up large boulders, and having never seen dynamite used for digging ditches, I became interested in a demonstration which your Company made in this neighborhood last summer. The test was made on a side hill underlaid with a ledge of magnesian limestone about five feet below the surface. Springs about half-way up the side hill kept the lower half of the hill and about six acres of the level ground below in an extremely wet condition. The soil is a sandy loam which contains a few small boulders and many large, flat stones thrown into various positions and weighing from 20 to sometimes over 150 pounds each. Hand digging in such ground is necessarily slow, for ditches have to be dug wide at the bottom to keep from caving in, and many large stones must be either broken up or removed with crowbars. There are several of these side hills in this neighborhood, and two men rarely average more than a rod and a half a day in digging ditches on such ground.

To cut the water off, a ditch four rods long was blasted out with dynamite, the amount used being evidently more than would have been necessary, for it not only opened a ditch of ample width, but shattered nearly a foot of the solid ledge of rock in the bottom. The cost was as follows:

Dynamite and caps with fuse	$3.00
1 man, 1 hour with dynamite	.25
1 man, 2 hours cleaning out bottom of ditch	.35
Total	$3.60 or 90c. a rod

With two men digging one and a half rods a day and getting each $1.75 a day, the cost per rod would have been $2.33 or over two and a half times more than the cost of digging with dynamite. This demonstration convinces me that on ordinary ground, especially heavy clay, the cost of digging with dynamite must be less than one-half the cost of hand digging. Furthermore, the work of digging with dynamite is done so rapidly that the advantage thereof cannot well be overlooked.

Very respectfully yours, LEO M. GEISMAR, Supt.

Underdrainage Increases Land Value $100.00 per Acre

FAYETTEVILLE, N. Y., Nov. 4, 1911.

You may be interested in learning that I had about six acres of worthless land, which was mostly bog and trash, that has been successfully drained with Red Cross Dynamite.

This land was always covered with water, due undoubtedly to a stratum of shale limestone underneath, but by drilling down through this limestone from 8 to 12 feet deep at the lowest spots in the swamp, I not only succeeded in draining the entire six acres, but since then it has been planted to corn and potatoes and now to alfalfa, which is yielding as high as five tons per acre.

The cost of this draining work was about $100.00 including cleaning up the brush, etc., which I consider most economical. In fact, I could not have drained this bog economically excepting by the use of dynamite.

I might also add that the value of this land has been increased from practically nothing to $100.00 per acre.

Yours very truly,

F. E. DAWLEY.

Tree Planting and Orchard Rejuvenation With Red Cross Dynamite

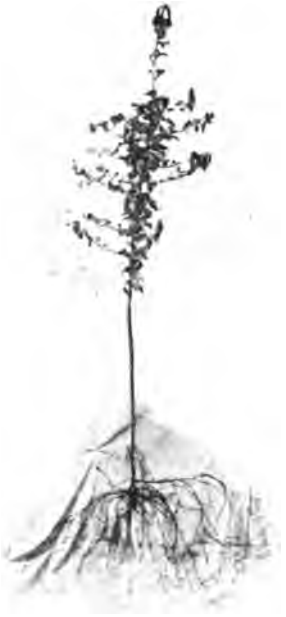


Fig. 35
Planted with Dynamite

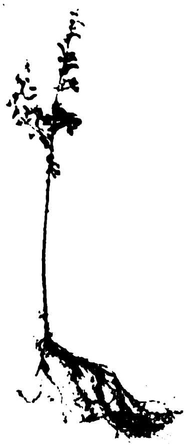


Fig. 36
Planted with Spade

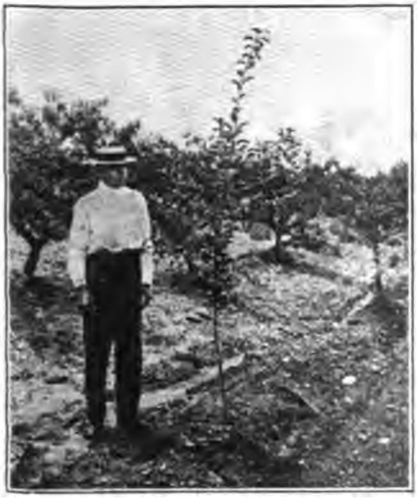


Fig. 37
Planted with Dynamite

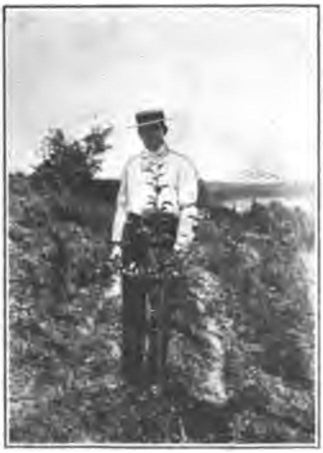


Fig. 38
Planted with Spade

One-Year-Old Apple Trees (In Ground and Dug Out) on Farm of E. G. Sexton, Canton, Ga.

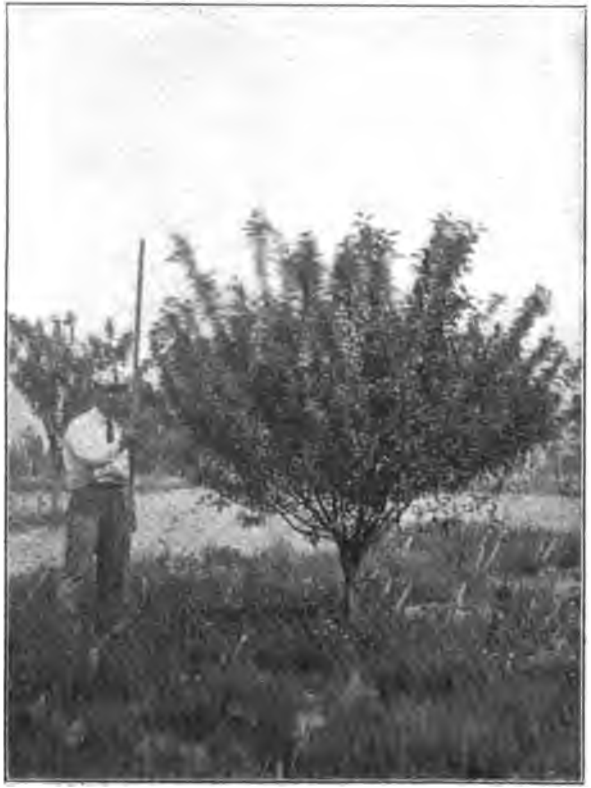


FIG. 39.—SIX-YEAR-OLD APPLE TREE, PLANTED IN SPADE-DUG HOLE, ROSE CLIFF FRUIT FARM, WAYNESBORO, VA.

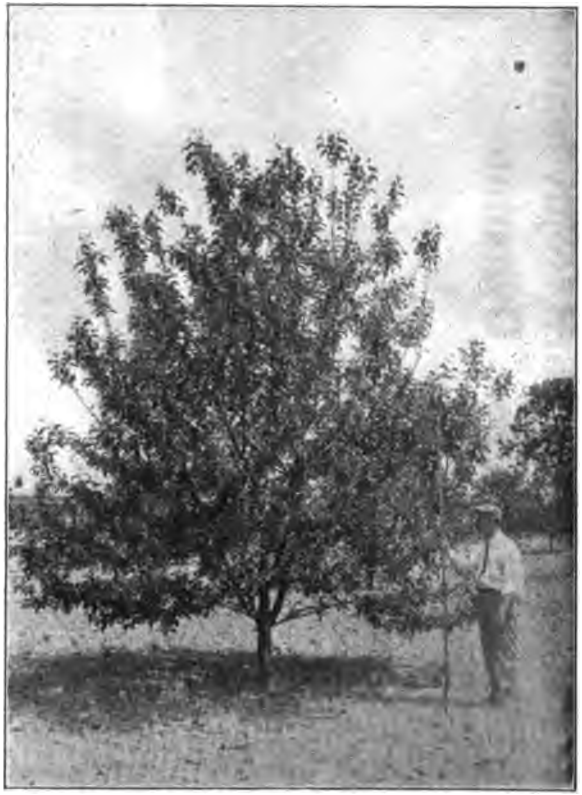


FIG. 40.—SIX-YEAR-OLD APPLE TREE, PLANTED WITH DYNAMITE IN SAME ORCHARD AS TREE IN FIG. 39

A Revolution in Orcharding

More than twenty years ago orchardists in California and in other states where hardpan is encountered, blasted tree-holes with dynamite to save the labor of digging them.

This practice led to the discovery that fruit trees set in dynamited holes developed much more rapidly than those set in spaded holes. They lived through drouths when others died. They came into bearing one to two years earlier than spade-set trees. They produced more and better fruit. Today the leading orchardists and nurserymen all use dynamite both for planting new trees and cultivating old ones, in all except loose, sandy soils.

Dynamite has almost entirely eliminated the gambling chances of orcharding. Even the frost-resisting qualities of dynamite-set trees are greater than those of spade-set trees.

In 1911 millions of fruit and nut trees were planted with dynamite.

In 1912 the number will probably be doubled or trebled.

In addition, the many millions of fruit and nut trees spade-set one to twenty years ago, may be forwarded in development or regenerated by dynamite.

Thus we are passing through an epoch of revolution in orcharding that means much to both grower and public.

Proved Results From the Use of Dynamite:

1. More Economical Than Any Other Method Because—
   - (a) The actual cost of planting is little if any greater than with spade.
   - (b) Dynamiting almost entirely prevents the big first year loss common to spade-set trees.
2. More Productive Than Any Other Method Because—
   - (a) Dynamite-set trees bear marketable fruit one to two years sooner than spade-set trees.
   - (b) The quantity of fruit is greater than on spade-set trees.
   - (c) The quality and color of fruit is better.

The Principles of Plant Growth

It has been conclusively proven that dynamite is an exceedingly valuable aid in the successful growing of trees. Those who have tried it are thoroughly convinced that no method of excavating the hole in which to plant a young tree is so economical, quick, or productive of desirable after-results as blasting with dynamite. We use the word "economical" in the sense described in our article regarding costs on page 53.

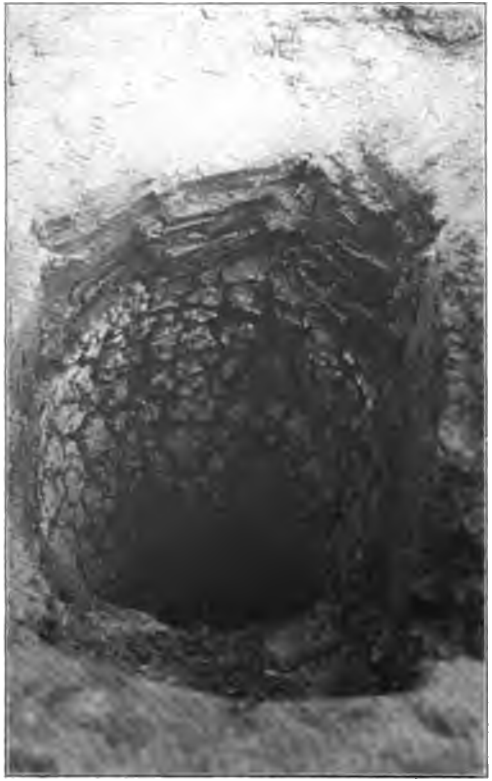


FIG. 41.—TOP OF HOLE BLASTED FOR PLANTING FRUIT TREE. (NOTE RADIAL FISSURES)

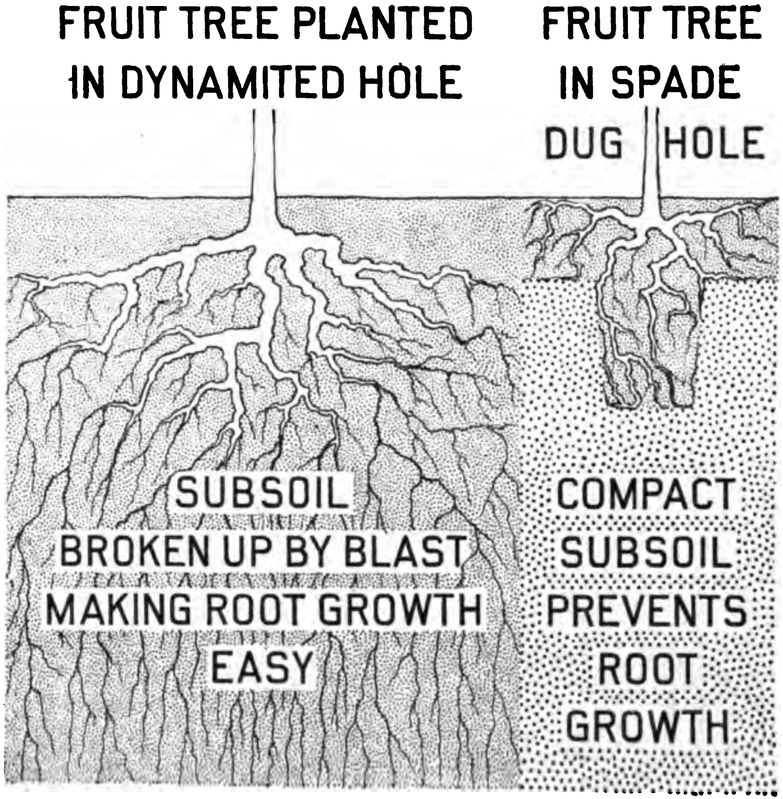


FIG. 42.—DIAGRAM OF SOIL SECTION

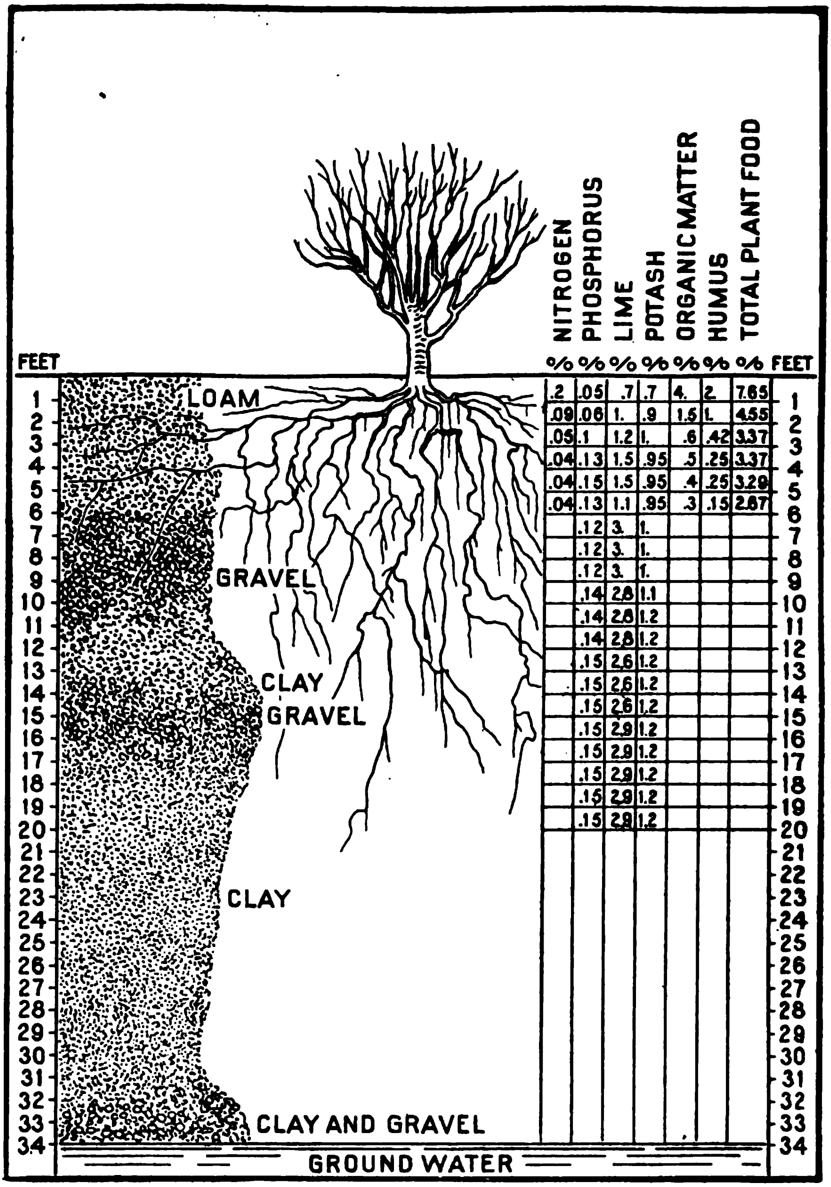
Sometime ago it was the prevailing idea that dynamite was unnecessary for tree planting unless the soil chanced to be underlaid with hardpan, in which case the explosive was regarded as valuable for breaking up the hard soil. It has been found by experiment however, that trees thrive better when planted in blasted holes than in hand-dug holes if there is underlying hardpan, or clay, clay loam or silty loams that are liable to become hard or impervious.

The explanation of this is simple. It is because the explosion of the dynamite loosens up the soil for yards around the spot, and thus makes root growth easy; whereas, digging the hole with tools tends to pack the earth around the sides and at the bottom of the hole and retard root growth.

Scientific agriculturists have discovered that water is the most important element in all kinds of plant growth. It forms a major portion of the green weight of the roots, trunk, branches, twigs, leaves and fruit of the plant. The proportion of moisture will, of course, vary in the different parts. The roots will be found to contain more moisture than the trunk, and the branches, twigs and fruit a larger percentage than the hard wood parts.

Water or soil moisture is the carrier of the tree's plant food. It also influences the temperature of the plant. In dry hot weather the evaporation of large amounts of water from the leaves of a tree has a slightly refrigerating action. It requires more heat units to raise a given weight of water one degree in temperature than it requires to cause a similar increase in the same weight of wood or stone. This is effective in saving trees from immediate harm due to quick changes of temperature. Moisture also has the effect of maintaining the stiffness of the more succulent parts of the plant. A good illustration of this is the noticeable withering of corn and other plant leaves when the supply of moisture is insufficient. Lack of moisture is just as effective in retarding the development of leaves of trees, but it is not so noticeable. Soil which is of the natural consistency to allow water to circulate freely through it and still retain or conserve it so that it is available at all times for growing plants, may be considered as ideal for agricultural purposes. Few soils possess this natural consistency. Other soils, which may be classified as good, average, or fair, must have artificial preparation in order to make them produce the results that may be expected from the rarely-found perfect natural soil.

Few persons understand the principle of plant growth. It is not necessary, as many suppose, that the root of a plant shall come in actual contact with all of the plant food elements of the soil needed for the sustenance of the plant or tree. Plant roots have the power to draw from the surrounding soil the necessary elements of plant food, provided the soil is of such a character as to permit the passage of these elements through it. Water or moisture is the carrier of these plant-food elements through the soil and into the plant roots. This will indicate the importance of a porous soil which will permit the free passage of water through it in order that plants growing upon the surface may be properly nurtured for rapid and healthy growth.



FEET	NITROGEN %	PHOSPHORUS %	LIME %	POTASH %	ORGANIC MATTER %	HUMUS %	TOTAL PLANT FOOD %
1	.2	.05	.7	.7	4.	2.	7.65
2	.09	.06	1.	.9	1.5	1.	4.55
3	.05	.1	1.2	1.	.6	.42	3.37
4	.04	.13	1.5	.95	.5	.25	3.37
5	.04	.15	1.5	.95	.4	.25	3.29
6	.04	.13	1.1	.95	.3	.15	2.67
7		.12	3.	1.			
8		.12	3.	1.			
9		.12	3.	1.			
10		.14	2.8	1.1			
11		.14	2.8	1.2			
12		.14	2.8	1.2			
13		.15	2.6	1.2			
14		.15	2.6	1.2			
15		.15	2.6	1.2			
16		.15	2.9	1.2			
17		.15	2.9	1.2			
18		.15	2.9	1.2			
19		.15	2.9	1.2			
20		.15	2.9	1.2			

FIG. 43

Soil section showing downward growth of roots to 21 feet, and percentages of various plant foods at different depths. As the drawing and tables were obtained from different sources, the percentages do not indicate those in the soil in the drawing, but are composite percentages from analyses of different soils.

This, together with the fact that the action of an explosive on soil causes it to become thoroughly mellowed and aerated, causes trees planted in blasted holes to show much stronger and healthier growth than trees planted under old conditions.

In order to give those who may not understand the subject an idea of the scientific principles of plant growth, we will quote W. J. Spillman, Agriculturist in charge of Farm Management Investigations, Bureau of Plant Industries, U. S. Department of Agriculture. He says in a recent bulletin:

"Plant food is dissolved in water. While a plant is growing, a constant stream of water flows up through it and evaporates at its leaves. For every pound of increase in dry matter made by the plant, from 300 to 500 pounds of water flow up through it.

"Plants in their growth make use of thirteen elements, nine of which they secure directly from the soil. These are called the mineral plant foods. They are phosphorus, potassium, calcium, magnesium, sodium, iron, silica, chlorin and sulphur. Soil consists mainly of small particles of rock. Nearly all kinds contain more or less of these mineral plant foods. Every year the soil water dissolves off a thin surface layer from each particle and plants appropriate this water, thus securing their mineral plant food. Hydrogen, another important element of plant food, is also secured from water.

"In order to produce a ton of hay on an acre of land, it is necessary that the growing grass pump up from that ground approximately 500 tons of water. In order to supply this enormous quantity of water, the soil must not only be in a condition to absorb and hold water well, but must be porous enough to permit water to flow freely through it.

"In addition to acting as a water carrier for plant life, soil must permit a proper circulation of air through it. Nearly half of the volume of ordinary soils is occupied by air spaces. Soil which becomes so compact as to stop the air passages, is too wet for most crops and needs drainage, for plant roots must be supplied with air and the soil must be porous enough to permit of its free circulation. One of the most important objects of plowing is to loosen up the soil and mix fresh air with it."

Orchardists and nurserymen who have had long experience in planting trees in holes prepared by dynamite blasts, have learned that compact subsoil is broken up by the blasts, which enable the land, thus made porous, to absorb plenty of water in rainy weather and store it up for the use of growing plants in dry weather. As Mr. Spillman says, this water in ascending to the plant roots carries with it the many necessary soluble fertilizing elements.

Few persons realize the depth of tree root expansion. In one of the "Farmers' Bulletins" issued by the United States Department of Agriculture, a cross section of orchard land is shown which we reproduce on the opposite page. Note the scale on the sides, indicating that this tree has sent its roots downward 21 feet into the soil. This is natural growth. Under normal conditions a healthy tree will seek its food in this way; but suppose a layer of hardpan or compact subsoil is encountered at a depth of two to six feet? The roots must then spread out near the surface for twenty feet or more. The result of this unnatural sidewise growth is that each tree in the orchard is compelled to go over into the feeding supply of its neighbor and consequently does not receive the necessary amount of plant food to properly nurture it and allow of its healthy growth. Its yield of fruit is also lessened by this forced encroaching of one tree on the feeding ground of its neighbor. Then, too, a brief dry spell exhausts all the moisture from the thin feeding ground of the tree, stopping its growth or killing it. From this it is not to be assumed that natural lateral growth is undesirable, but simply means that hardpan prevents practically all downward growth. A tree growing under these conditions is also quite likely to be blown over by wind.

Dynamite blasting proves a simple and effective remedy for this condition. The blast breaks up the hard soil and permits the roots to take their natural downward course into the lower strata in which plenty of plant food elements are available. Under these conditions, one tree is not interfered with by another; each one receives the benefit of all of the soil allotted to it when at the time of planting the surface was measured and laid out.

It must not be assumed that dynamite blasting is beneficial only when the topsoil is underlaid with hardpan. It is of the utmost importance to assist a tree, especially a young one, to send its roots out into its feeding bed as easily and rapidly as possible. The more porous and mellow the soil, provided it is one of the type of soils liable to be found in compact condition, the more rapid will be the growth. Even in the deep loamy soils of Oregon, among the most perfect for fruit tree culture found in the United States, blasting has proven extremely beneficial in forwarding the growth of young fruit trees, as is shown in the letter of Orchardist Rawley, which appears on page 63 of this booklet.

The main object to be sought in tree planting is to so prepare the ground that the growing tree can absorb the largest possible percentage of moisture from the soil which it occupies. Loosening and aerating the soil permits it to absorb more of the rainfall and store it against the future needs of the tree. A Cornell University authority advises that a tree planted in soil properly prepared, can absorb 60 per cent. of the moisture contained in it.

Professor Fabian Garcia, of the New Mexico Agricultural Experiment Station, who has conducted a considerable amount of experimental work, much of which was in an intensely practical way, makes the following statement:

"The hope and desire of every orchardist is to have the roots of his fruit trees grow down as deeply as possible. There is no doubt that the deeper the roots grow the better it is for the trees, and the longer lived they are."

Dynamite Method is Most Economical

Most fruit growers who have tried dynamite for tree planting are ready to admit that the method is productive of good results, and that the work can be done more quickly than by old-fashioned methods.

Many hesitate to adopt it, however, because they reason that it is more costly. There are some features of this question of cost that deserve serious consideration. Many people deceive themselves when they attempt to figure costs.

Dynamite Prevents the Big First Year Loss

According to those who have used dynamite for tree planting, the loss from death of trees planted in that way is considerably lower than when trees are planted in spade-dug holes.

Mr. J. H. Baird, Superintendent of the famous Hale Georgia Orchard, of Fort Valley, Ga., one of the most experienced and highly trained orchardists in the United States, says that Mr. Hale's loss of trees planted with dynamite does not exceed 2 per cent., whereas the trees planted on their Georgia properties in the old-fashioned way have suffered losses of around 50 per cent.

Dynamite Saves New Settings, Although Ground Had Never Been Plowed

PARKERSBURG, W. VA., July 8, 1911.

Gentlemen.—Our first experience with dynamite in orchard work was during the spring of 1911. The season in this locality has been extremely unfavorable for starting a young orchard. The soil has been unusually dry ever since the trees were planted.

As we considered the use of dynamite in the orchard work in the nature of an experiment, we left a number of checks for comparison. We used dynamite for digging holes for planting of apples, pears, quinces, cherries and plums. In all these, the trees were planted in sod, and the ground was not broken except with dynamite. In other portions of our orchard the same kinds of trees were planted in ground that was carefully plowed and has been since cultivated several times. There is no decided difference in the trees planted by the two methods. Where the trees were planted in sod, however, without the use of dynamite, from *sixty to seventy-five per cent. are dead.* Whereas, where the dynamite was used, the loss will not exceed *two or three per cent.*, and in the cases where the loss occurs, the cause is foreign to natural conditions.

In addition to the large fruits above mentioned, we have just recently cultivated a vineyard by putting in small shots one-third of a stick each, every eight feet in the row. We were led to do this after seeing what we believe to be decided benefits in its use for planting and cultivating apples and other fruits.

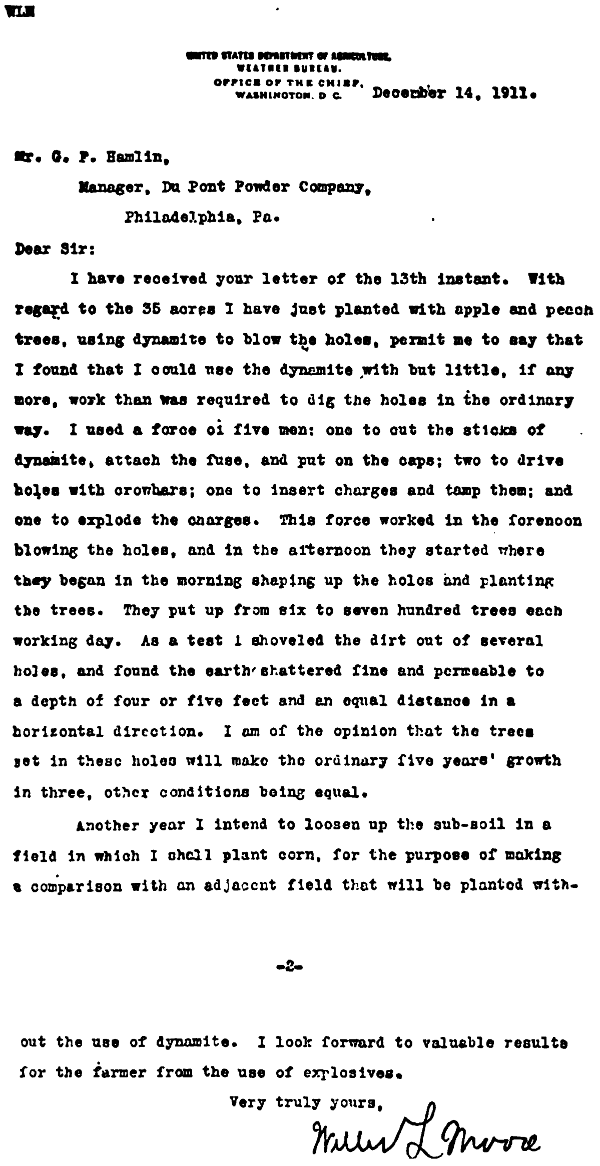
In addition to this, we used dynamite for cultivating, in a limited way, an old orchard. The trees in this orchard are from twenty to thirty years of age. Up to the present season the orchard has been badly neglected. We used one-third of a stick directly under the trunk of the tree, about three and one-half feet deep. The explosion did not disrupt the surface but evidently broke up the subsoil and destroyed the old formation which bound the roots of the trees. This was used early in the season before the trees were in bloom. These trees at this time show a decided advantage over trees in the same orchard under like conditions, which were not so treated. The growth has been *at least twenty-five per cent. greater, they are loaded more heavily with fruit than the other trees, the fruit is larger in size,* and the leaves and general appearance of the trees indicate a more vigorous thrifty condition. We consider the use of dynamite in the cultivation of an orchard, as above described, one of the most beneficial purposes to which its use is adapted.

Our experience, up to this time, indicates a more extensive use of dynamite in the future. Its use is both expeditious and economical. Its benefits are peculiarly apparent in a dry season like this. By its use the roots of the trees are permitted a greater penetration than would be possible by any other method, thus to a certain extent making the tree independent of surface conditions.

We used, approximately, a ton of dynamite this season, without the slightest accident. The men become familiar with its use and do not consider the labor hazardous.

ROSEMAR ORCHARD COMPANY.

Dynamiting Highly Endorsed by Chief Moore of U. S. Weather Bureau



WLM

UNITED STATES DEPARTMENT OF AGRICULTURE.
WEATHER BUREAU.
OFFICE OF THE CHIEF,
WASHINGTON, D. C.

December 14, 1911.

Mr. G. P. Hamlin,
Manager, Du Pont Powder Company,
Philadelphia, Pa.

Dear Sir:

I have received your letter of the 13th instant. With regard to the 35 acres I have just planted with apple and peach trees, using dynamite to blow the holes, permit me to say that I found that I could use the dynamite with but little, if any more, work than was required to dig the holes in the ordinary way. I used a force of five men: one to cut the sticks of dynamite, attach the fuse, and put on the caps; two to drive holes with crowbars; one to insert charges and tamp them; and one to explode the charges. This force worked in the forenoon blowing the holes, and in the afternoon they started where they began in the morning shaping up the holes and planting the trees. They put up from six to seven hundred trees each working day. As a test I shoveled the dirt out of several holes, and found the earth shattered fine and permeable to a depth of four or five feet and an equal distance in a horizontal direction. I am of the opinion that the trees set in these holes will make the ordinary five years' growth in three, other conditions being equal.

Another year I intend to loosen up the sub-soil in a field in which I shall plant corn, for the purpose of making a comparison with an adjacent field that will be planted with-

-2-

out the use of dynamite. I look forward to valuable results for the farmer from the use of explosives.

Very truly yours,

Willis L. Moore

From this it is apparent that in considering the question of economy we must go beyond first costs. Assuming that young apple trees, for instance, cost 20 cents apiece, and that 1,000 are planted. If 2 per cent. of them die, the loss will be 20 trees, worth $4.00. If 50 per cent. die, the loss will be 500 trees, representing a money loss of $100.00, which the dead trees cost. To plant 1,000 trees with dynamite would cost for materials from $60.00 to $65.00. Leaving labor out of the calculation altogether, the orchardist saves $96.00 worth of trees by planting with dynamite. Charging the $65.00 blasting cost against that, still leaves him $31.00 in pocket in spite of the outlay for dynamite, caps and fuse.

Dynamite Saves Time and Labor

But that is not the only saving. It seems to be very generally admitted by those who have used dynamite for tree planting that the work can be done much faster by that method than when the holes are prepared with spades. The saving in labor then becomes a large item. If trees are planted according to the most approved horticultural methods —that is, in very large holes dug out to thoroughly pulverize the soil for from two or three feet in every direction from the trunk of the tree, and to a depth of at least two feet—a laborer can plant a tree with dynamite in one-tenth the time it takes to plant it with a spade.

One Blaster Replaces Twenty-five Tree Planters

The following is quoted from a trade report of a Du Pont Salesman:

"When I called on this party (Dr. J. T. Kelley, of Quicksburg, Va.) he had about 25 men out digging holes and had never thought of using dynamite, although he had heard of it. After talking to him a few minutes I asked him if he would take the time to go over in the field and let me show him how it was done. I had the necessary explosives with me. He gave me the time and I got him to thinking. He asked me to stay all night and give him a chance to think it over. So I stayed and talked over the whole thing with him that night, and before we retired he asked me if I would go with him up the country early in the morning to where he had his men digging and show them all about it. He said if he decided to blow the holes he wanted the men to understand all about it, and that they would understand better if they saw it. By 7.15 we were at the farm and found 25 men working. He called them all to quit work and come and see how we could blow holes. I could not look the men in the face, for I felt it meant their jobs, and after I had shot a hole or two, I heard one fellow say, 'That fellow is going to cut us out of our job.' Sequel: In one hour they had all been paid off for a half day's time and sent away."

Dynamited Trees Bear Earlier

There is also another feature that must be considered in connection with the question of economy—that is, the claim of experienced orchardists that trees come into bearing from one to two years earlier when planted in dynamited holes.

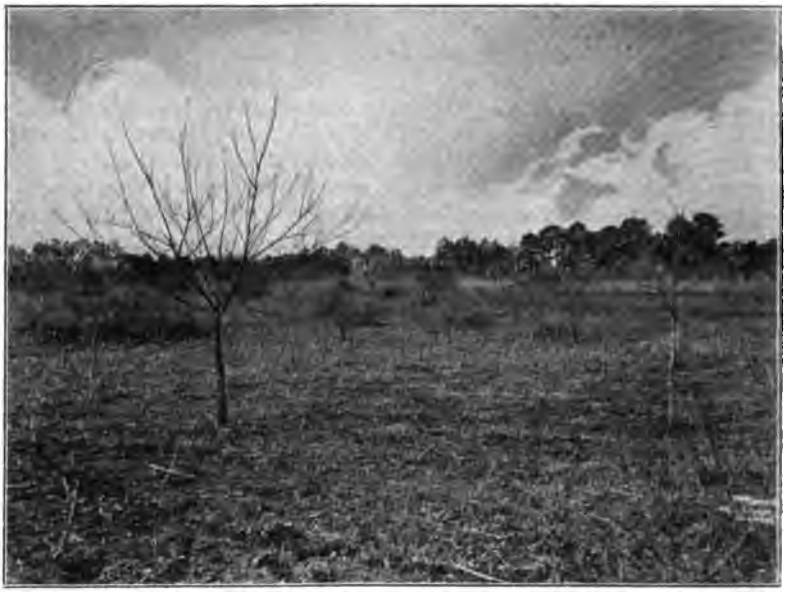
Gained Two Years by Planting with Dynamite

Gentlemen:—It may be a surprise to you to learn that I have been using dynamite for planting trees for a number of years, and have some shade trees planted in that way eighteen or twenty years ago. They are the finest trees I have ever seen grow for their age. In the planting of peach trees I gained two years in six; in other words, I got as much fruit from a tree planted with dynamite at four years old as we usually get at six years old.

I not only plant them with it, but where a tree is failing and seems to be on the decline I start it off to growing again by firing charges from three to ten feet apart.

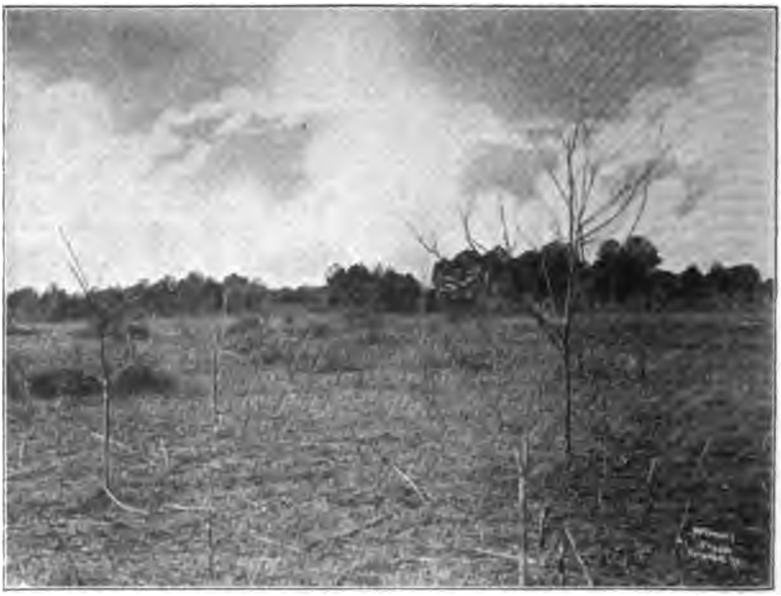
Nothing seems to tickle the earth so much as planting watermelons after explosion of dynamite from three to four feet under ground. I plant them twenty feet apart each way. Fertilize heavily and the vines bear right on until frost, the entire summer.

W. W. STEVENS, Orchardist, Mayfield, Ga.



Dynamite-set **Spade-set**

FIG. 44



Spade-set **Dynamite-set**

FIG. 45

Pecan trees planted Jan., 1906, on land of F. W. McMurrain, Columbus, Ga.

It is not contended that this more rapid growth is due to the fact that dynamite is a fertilizer, but because the blasting makes the soil thoroughly porous and mellow, and gives the tree roots an opportunity to expand easily; also because the increased moisture-storage capacity of the shattered soil forwards the development of the tree. Therefore, the value of one or two years' crops must be added to the cost of the original tree planting in spade-dug holes, or deducted from the cost of preparing the holes with dynamite. This would more than counterbalance the one to three cents per tree planting cost, which close calculating orchardists regard as the difference between planting in the old-fashioned way and planting with dynamite.

Horticultural experts state that the average tree cannot thrive when it is planted in a little spade-dug hole about the size of a large flower pot.

The proper way to plant a tree with a spade is described in a paper on tree culture read by a horticulturist at the meeting of the Kansas State Horticultural Society, held in Topeka, Kansas, in December, 1909. The following are extracts from the paper:

"The soil should be stirred as deep as it well can be, the deeper the better. In digging your tree holes, forget that you are going to plant a tree, and imagine you are going to bury the largest horse on the place, and dig accordingly. Remember it is the last chance you will have to loosen up that soil, so do a good job. Plant your trees deep, getting the roots down where it never gets dry."

One of the largest and most successful nurseries in the country is that of the William H. Moon Company, of Morrisville, Pa. In their book, entitled, "How to Plant a Tree," they say: "Holes must be made so large that the roots may spread out naturally without cramping." That means for one and two-year-old nursery stock a hole at least 18 to 24 inches across and nearly as deep. When an inexperienced fruit grower claims to be able to plant a tree for three or four cents per hole, of course he tells the truth. He can; but he can't plant it right for that cost. He can also build a house for $9.00, but do you want that kind of a house?

To dig a hole as large as these experts advise, with ordinary tools, would require much time and labor. Half a cartridge of dynamite will loosen up the ground, and make it porous in an instant.

Expert Advice From a Professor of Horticulture

Deep Rooted Trees Resist Drouth and Frost

"I believe it is of fundamental importance to plant trees in soil loose and open enough, and well enough drained so the roots can go down deep. For example, the peach trees in the deep loam where they root deep blossom as early in spring as do shallow rooted peach trees in adjacent clay soil. Those in the deep, mellow loam, however, will endure more cold and will set full crops much more frequently than do these same varieties over a hard clay subsoil. The trees mature better, apparently store up more sugars and other materials in their buds for winter, and do not have their fruit buds killed at the same temperature as do trees on hard clay subsoil. We have taken twigs in full bloom, surrounded them with a freezing chamber so as to find out at just what temperature the bloom would be killed. Those growing in the deep well-drained soil will sometimes endure as low as 26 degrees, or 6 degrees below freezing, without the flowers being killed when in full bloom. Similar trees grown where they did not root down well, would not endure drought of summer in as good health, due to the packed subsoil, and often have their flowers killed at 28 to 29 degrees or about 3 degrees below the freezing point of water."

J. C. WHITTEN,
Professor of Horticulture, University of Missouri, Columbia, Mo.

Dynamited New Trees Successfully Survived Drouth

NEW ALBANY, IND., June 29, 1911.

Gentlemen:—I used dynamite in planting my orchard of more than four thousand trees. I used one-third of a stick of 40% dynamite for each tree. I drilled a hole for each tree about two feet deep, tamped the dynamite tightly, and exploded each charge with fuse and blasting cap. The explosion loosened the soil within a radius of about four feet to a depth of about thirty-six inches.

With my long experience of planting trees, I find the use of dynamite the most successful method. The loosened soil acts as a reservoir to hold moisture. I planted my orchard in the spring and find that my loss of dead trees will not exceed 5%, notwithstanding the fact that we have had a six weeks' drouth, this low percentage being due to the loosened soil holding moisture. Under no circumstances would I think of planting an orchard without the use of dynamite. I recommend it as the cheapest, quickest, most successful and most satisfactory method.

NEWTON A. GREENE, Mayor, City of New Albany, Ind.

Famous Orchardist Uses Dynamite in Planting and Renovating Peach Orchards

E. I. DU PONT DE NEMOURS POWDER CO., Wilmington, Del. Feb. 22, 1911.

Gentlemen:—I am just back from a two weeks' stay in our Georgia Orchards.

While I was there we continued further blasting for the replanting of about 3,000 trees where they had failed in one of our older orchards. I also looked over carefully the two little blocks of trees we planted with dynamite last season and the results are even better than I had been led to believe when I left there the middle of July. In the meantime I am becoming further interested in the matter and in the recommendations for renovating some of the old apple orchards in New England and want my clients to try dynamiting a portion of the land around these trees, especially when they are in particularly strong heavy soil. Yours, J. H. HALE.

NOTE.—Mr. Hale is the owner of several of the largest commercial orchards in the United States.

Mr. Hale wrote us as follows, December 18, 1911:

Our experiments with the use of dynamite in planting peach trees in our Georgia orchard in 1909, and continued on a larger scale the next two years, are giving us such promising results that I am inclined to go a little further into the matter in planting eight or ten thousand trees down there this winter, and possibly in planting quite a large lot of peach and apple here in Connecticut the coming spring, and so am writing now to know what special prices you can make us on the dynamite, caps, fuse, etc., delivered at Fort Valley, Georgia, as early in the month of January as possible. J. H. HALE.

Explanatory Note

Several orchardists who have read our booklet have asked why it is that we recommend our Red Cross 20% Dynamite for tree planting and orchard rejuvenation, when many of the orchardists who have given us testimonials, which are published in the booklet, speak of having used 40% grade.

It is because the 20% grade has not been generally carried in stock by dealers throughout the country up to a very few months ago. The 40% grade has been more conveniently obtainable and hence more generally used. Of course, the 40% strength gives very satisfactory results in tree planting, but as our experiments have convinced us that the 20% grade is fully as good and, under most conditions, a little better and is cheaper than the 40% grade, we recommend it.

Dynamite Method is More Productive

Results of Blasting on Rose Cliff Fruit Farm

Dynamite Kills Fungus Diseases **Makes Trees Grow Twice as Fast**

Having learned that Mr. James Craig, President of the Rose Cliff Fruit Farm of Waynesboro, Va., had been using dynamite in the tree planting and regeneration work in his extensive orchards for several years, we sent an investigator to obtain his views. The following is a report of the interview:

Mr. Craig is a very progressive fruit grower. He is one of the first among Eastern orchardists to employ orchard heaters; as a result of this enterprise the fruit on his trees was saved in the spring of 1911, when a heavy frost killed all other fruit in the neighborhood. Mr. Craig has also used dynamite for killing fungus diseases in the ground under and around old trees which have died of fungus diseases. As a result, he has been able to use the ground for replanting, something which has been considered inadvisable previously.

Our representative obtained a number of photographs of trees on Mr. Craig's property, some of which we reproduce in this booklet.

Figure 40 shows a six-year-old apple tree planted in ground prepared by exploding a half cartridge of 40% strength Dynamite at a depth of eighteen inches.

Figure 39 shows a view of another tree planted in the same month of the same year by the ordinary method of digging a hole with spade and pick. By comparing the height of this tree with the man holding an eight foot rod in his hand, also shown in each picture, the difference in the size of the trees can easily be seen.

Figure 47 shows a nine-year-old tree planted in ground prepared by blasting a half cartridge of 40% strength Dynamite at a depth of eighteen inches. Figure 46 shows a nine-year-old tree planted in a spade-dug hole. The two trees just referred to are not 200 feet apart.

The soils in both plots shown are practically identical; the trees in these orchards are both of the same species of apple; but, as will be noted from the photographs, the trees planted with dynamite show very good growth, whereas the trees which were not planted with dynamite show up poorly.

In February of 1911 Mr. Craig did some blasting in his orchard, midway between his trees, with a view of loosening up the soil. He used in each hole one-half cartridge of 40% Red Cross Extra Dynamite, exploded at a depth of eighteen inches. One of the objects of this blasting was to break up some shale underlying a great many of the trees and preventing the deep growth of the roots. To see what results these blasts accomplished, some of the soil was afterwards dug out with shovels. It was discovered that the ground had been broken up at a radius of from six and one-half to eight and one-half feet from the point of the blast, thus giving the tree roots an opportunity for deeper and more healthy expansion.

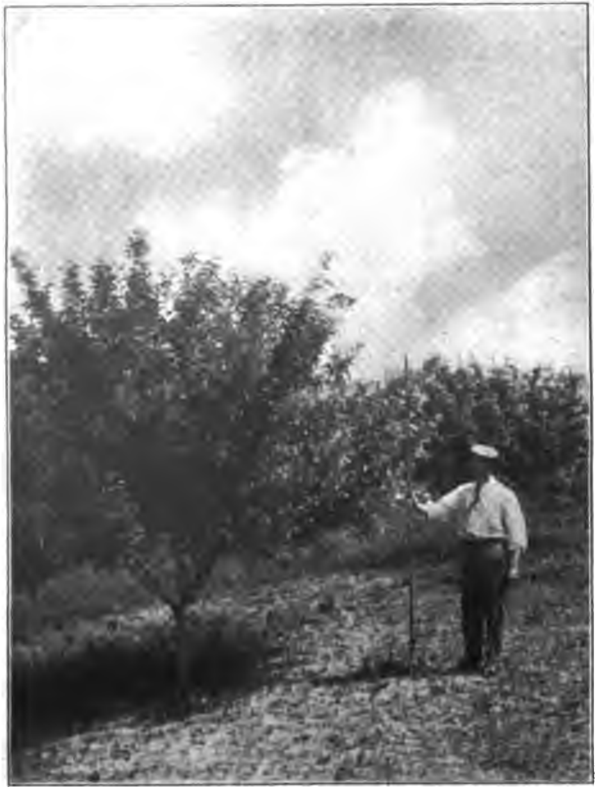


FIG. 46

Nine-year-old apple trees planted in ordinary manner with shovel, same variety and age as Fig. 47 and not 200 feet away, same soil. Apple trees planted 30 feet apart on square system.

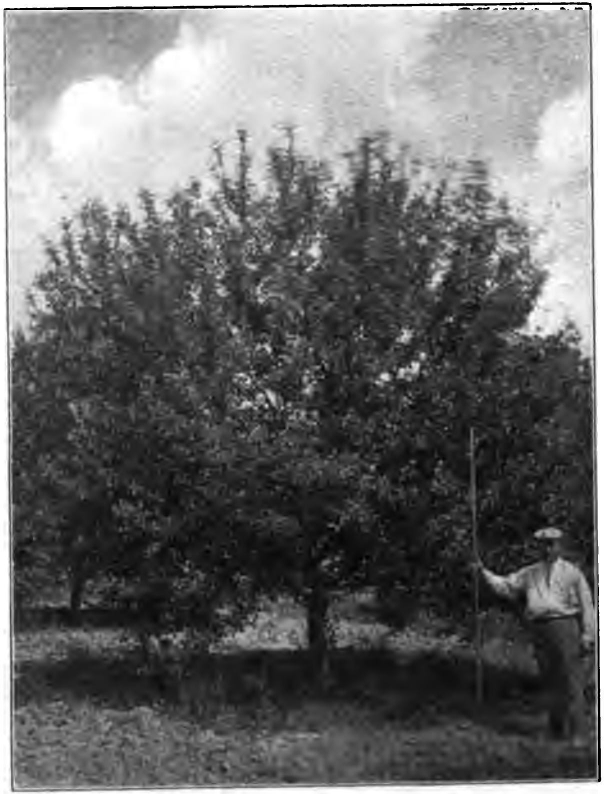


FIG. 47

Nine-year-old apple trees planted in ground shattered with ½ cartridge 40% dynamite placed at depth of 18 inches. Apple trees planted 30 feet apart on square system

A Controversy Settled

MR. JAMES CRAIG, PRESIDENT, WILMINGTON, DEL., February, 6, 1912.
Rose Cliff Fruit Farm, Waynesboro, Va.

Dear Mr. Craig:

File A-3718: *ROSE CLIFF FRUIT FARM.*

Referring to the cuts used in our Tree Planting Booklet (copy of which I enclose), showing the comparison in growth between trees planted with spade and with dynamite in your orchard:

These pictures have been criticised by orchardists to some extent, as being an unfair comparison because the dynamited tree is in cultivated ground and the spaded tree is in ground not so well cared for.

I understand some people who have visited your orchard have also said that the smaller tree had not received the same attention in spraying, pruning, etc., as the larger tree.

Will you be kind enough to advise me whether there is any truth in these statements, and whether you think the pictures we are using are an unfair comparison or not.

I enclose a stamped envelope for reply, and would greatly appreciate your attention to this matter. Very truly yours,

GEORGE FRANK LORD,
Manager Agricultural Division.

MR. GEORGE FRANK LORD, WAYNESBORO, VA., February 9, 1912.
WILMINGTON, DEL.

Dear Sir:

Your favor of February 6th received. In regard to the two trees that you make a comparison of, beg to say that there is probably some slight difference in the culture and care of these two trees, yet the care that the small tree has had should have developed as large a tree as the other one, as it has been sprayed well, has been cultivated and has also had two coats of barnyard manure while the other one has not had any barnyard manure at all, yet it has good culture and has been well sprayed. I think if the other tree had been set in a dynamite hole it would have shown practically the same growth. I am sure the ground will grow as fine a tree as the one shown in the picture. Of course it can be criticised and it is right hard to make a comparison of any two trees without showing some difference in the care.

I do not doubt that dynamiting the ground planted to trees is of the greatest advantage possible. The American Apple Company, of which I am Vice-President, set the past May 500 "Delicious" trees on a sloping hillside and without any special care given them except dynamiting (as it was so late in the season we could not get the ground prepared as well as we would have liked), yet these trees have made a very fine growth, as fine as any we have set, and we only lost about three trees in the 500, yet we had a drought that was unprecedented in this part of the country. This satisfies me conclusively that the blowing of these holes offered a loose pliable ground for many feet around which retained the moisture and in this way the trees did not suffer, but made an immense growth which can be seen by any one visiting us. Yours very truly,

ROSE CLIFF FRUIT FARM, Inc.,
JAMES CRAIG, President.

Dynamite Used in Largest Peach Orchard in U. S.

Superintendent J. H. Baird, of the famous Hale Georgia Orchard, of Fort Valley, Georgia, writes under date of May 20th, 1911:

"The trees planted this season with dynamite are growing beautifully and we have not lost any through drouth, while those planted without dynamite have died out badly and show poor growth."

On June 17, 1911, Mr. Baird again writes:

"Vegetation is burning up here for lack of rain, but the young trees have lived beautifully; do not think we have lost over 2% of those planted with dynamite, while of the others planted in the old fashioned way we have lost from 50% up."

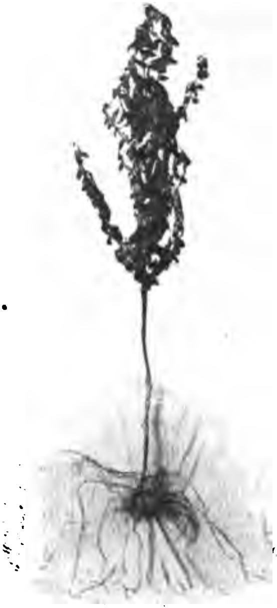


Fig. 48.—Planted with Red Cross Dynamite

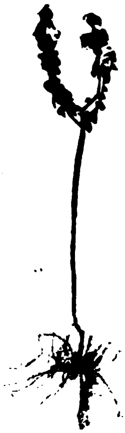


Fig. 49.—Planted with Spade

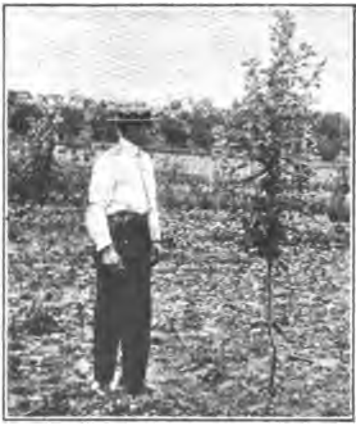


Fig. 50.—Planted with Red Cross Dynamite

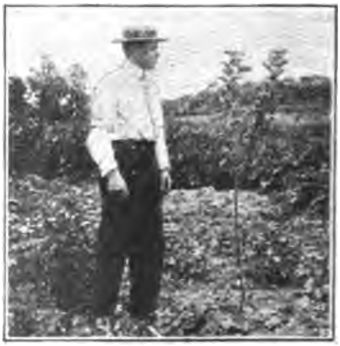


Fig. 51.—Planted with Spade

Two-Year-Old Apple Trees (In Ground and Dug Out) on Farm of E. G. Sexton, Canton, Ga.

Found That Dynamite Kills Fungus

August 10, 1911.

Gentlemen:

A few years ago I experimented in planting trees with dynamite. It was a decided success. My neighbors observed the results and now many of them are talking of using this method hereafter. My observations were as follows:

1st. Made new land out of old. It made a drainage for stagnant waters and provision for carrying moisture down in the wet season and up in the dry season by breaking up and pulverizing the soil and establishing a capillary attraction between moisture beneath and air above.

2nd. In resetting an old orchard of diseased or dead trees, it is regarded as fatal to reset, without digging the hole and letting it stand for a year or two. If the old tree is blown out with dynamite and the ground left for a few hours with fumes imbedded, it will kill all fungus, bacteria, grubs, and animal parasites. The tree thus treated will grow and do as well as on virgin soil.

3rd. The tree will have more vigor and vitality, will grow faster, bear earlier, and be more productive and longer lived.

4th. The combined cost of blowing hole and planting tree is but a trifle more than digging hole and planting tree the old way.

Very truly yours,

J. A. TEAGARDEN, Auburn, Cal.

Kills Fungus

ARBOR HILL NURSERIES, SALES GROUNDS AT SUMMIT STATION,
BROWNWOOD, TEX., Nov. 4, 1911.

One experiment I made while at Arlington, Texas, in application of dynamite will no doubt be of interest to you.

In spring of 1910 I planted a number of cherry trees upon a plot of land that was infested in spots by rot fungus; and I happened to plant one of these cherry trees in one of those spots; said tree was dead by the first of June, 1910, with roots rotted.

Last winter I placed a stick of dynamite about 30 inches deep in the same identical spot, exploded it and immediately planted another cherry tree, which grew well during all the past summer and fall without showing any indication of root rot.

I believe the organism of root rot disease is delicate enough that a shock occasioned by explosion of dynamite will destroy it within considerable distance of centre of explosion.

Very truly yours,

CHAS. F. WARD.

Two Men and Dynamite One Day Better Than Three Men One Week Without Dynamite

A. F. BORNOT BRO. CO., 17TH STREET AND FAIRMOUNT AVENUE,
PHILADELPHIA, PA., April 26, 1911.

Dear Sirs:

Your Mr. Fulmer was here Monday and together we made about one hundred holes which has enabled my gardener to plant one hundred peach trees the following day. Three men could not have done the same amount of work in a week. The ground is now very loose; I am more than pleased and would not plant another tree on my place without explosives.

Very respectfully,

A. F. BORNOT BRO. CO. L.

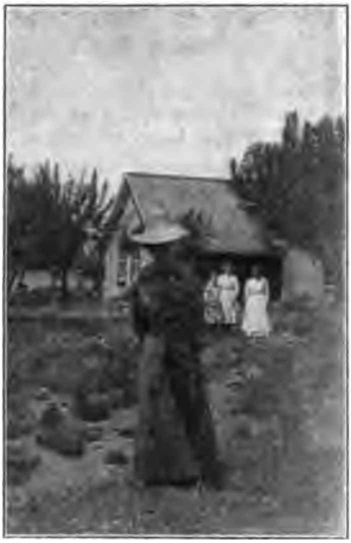


Fig. 52
Two-Year-Old Apple Tree Set in Spaded Hole

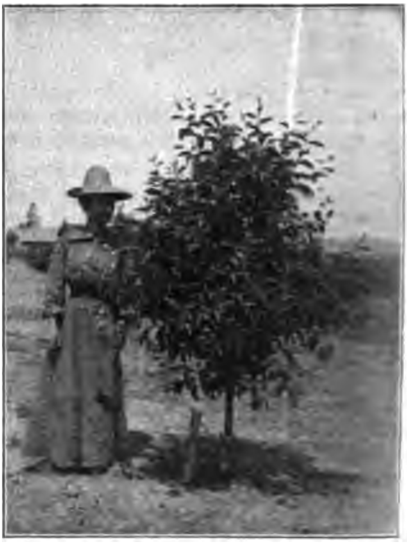


Fig. 53
Two-Year-Old Apple Tree Set in Dynamited Hole

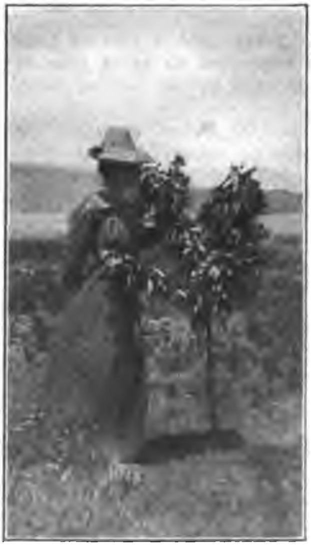


Fig. 54
Bing Cherry Tree, Two Years Old, Set in Spaded Hole

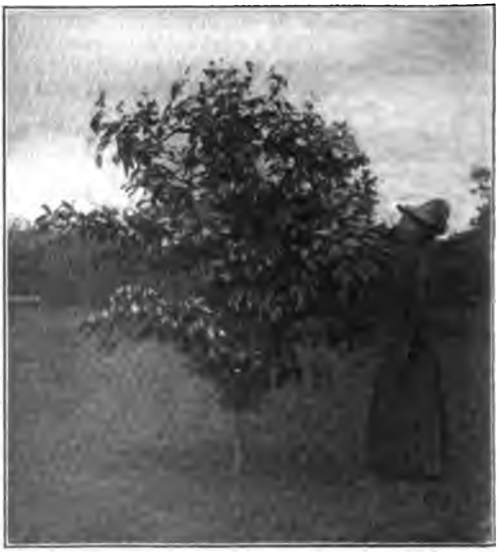


Fig. 55
Bing Cherry Tree, Two Years Old, Set in Dynamited Hole

Dynamite Tree Planting Shows Fine Results In Five Feet Oregon Loam

GRANTS PASS, OREGON, May 12, 1911.

Gentlemen:—I am sending you photographs of four trees.

Figs. 52 and 53 are Bellflower apple trees; Fig. 52 was set in a spade-dug hole, and Fig. 53 in a dynamited hole.

Figs. 54 and 55 are Bing cherry trees; Fig. 54 was set in a spade-dug hole, and Fig. 55 in a dynamited hole.

These four trees were part of a shipment of year old nursery stock received and set out the latter part of March, 1909. The photographs were taken about the 15th of April, 1911, two years after setting out, just as they were coming into leaf.

Bellflower apple tree (Fig. 53) was pinched back in June, 1909, about ten weeks after planting. It was shortened in by removing some two feet of growth from each main lateral the following November. In 1910 it had the same treatment. It is a very vigorous tree with healthy foliage and fine color.

Bellflower apple tree (Fig. 52) had as good ground to grow in, but was spade-set and made such small growth it needed neither pinching back nor pruning. Not a bit of growth, not a leaf has been removed from the head of this tree since planting. The trunk is less than half inch in diameter, while the dynamite-set mate to it has several branches thicker and finer than the trunk of Fig. 52.

The Bing cherry trees (Figs. 54 and 55) have the same identical history as Bellflower apples (Figs. 52 and 53) with the exception that we did not shorten in at fall pruning (Fig. 55) as much as we did apple No. 53.

We have heavier tops and taller trees of these varieties in the orchard, but these trees are two favorites, very typical of their kind and strike a favorable average for the lot of five hundred. From 250 apple trees so set we got a perfect stand, not one died.

We use dynamite for making holes in planting trees on our very best and deepest ground, as well as the poor spots. It is much cheaper than hand labor, it is much quicker when speed is a most important point and delay will cause the loss of many trees. It insures every advantage to the tree getting a good start.

After the orchard is staked, one man with a shovel removes a circle of surface soil from about the stake, usually five cuts or so, which is laid to one side to use in filling the hole to proper level before setting the tree with the roots carefully pruned back.

A second man follows the first with a crowbar and works the hole down where the stake comes out. If a stone or anything of the sort is encountered we dig it out. If a spot of hard sediment or hardpan is encountered the hole is put through. These holes are about eighteen inches deep. We use one stick of dynamite properly fitted with 18 inches of best fuse for the average hole. It is dropped to the bottom of the hole and tamped down, then the fuse is lighted. There is very little stuff thrown up, the force going downward and outward. The holes are allowed to stand probably over night, or part of the next day, are probed with a crowbar, and, if satisfactory, the sides are broken in, the top earth at one side filled in, and the hole is ready for the tree.

We have set all our trees in wet weather, which insures a storage of moisture under the tree. If one were compelled to set in dry earth, a generous supply of water should be added to settle the hole prior to throwing on top earth that makes the bed for the tree to set on. Twice each spring a circle should be worked up to a fine mulch about the depth of a spading fork, and kept loose, unbaked and free of weeds.

Last November we had occasion to remove some filler trees, Grimes Golden apples, seven months after setting out, one of which was spade-set. They were taken up with the greatest care so we could get the roots out intact just to prove to ourselves what difference in root growth we would find in same variety, in perfectly matched trees on the same ground from the two methods of setting.

The spade-set tree had a fine bushy and vigorous tassel of roots about a foot long. The dynamite-set tree had two roots going down some three feet. I held it out at arm's length, my hand clasped around the graft scar, and the roots touched the earth. Also it had a great quantity of medium and short growth roots. The difference was so convincing that we now have thirty acres of new orchard and every tree is set with dynamite.

You will probably be amused at my zeal, but I used half sticks of dynamite in making up a rose bed, and also for a hardy border set with peonies and other perennials. Am happy to say the peony plants are now ready to bloom profusely their first season, although, hitherto, I have failed to bloom them before the second or third year.

We wouldn't undertake to clear ground or set new trees, shade or orchard, without using dynamite, notwithstanding our soil is a beautiful loam, with little stone in it, and runs from five to six feet deep.

MRS. JOHN RAWLEY.

Prominent Nurserymen Describe Successful Methods

Harrison Brothers, with nurseries at Berlin, Maryland, have 4,000 acres, which contain more than 200,000 trees, and they are among the leading nurserymen of the East. They have prepared a very complete book entitled "How to Grow and Market Fruit," retailing at 50c. a copy, containing valuable information.

They say, "What is stated here is the most practical kind of hard-won knowledge, for it outlines 'how we do it' in fruit-culture."

From the chapter on "Methods of Keeping Moisture":

"Subsoiling with dynamite is a thoroughly practical method, and should be employed on three-fourths of the farms of the East.

"By far the best way to loosen subsoil is with dynamite. This is not generally known, but orchardists will find they can reduce tillage expenses greatly and save much time with it. The exploding of from a sixth to a half pound of the right kind, two or three feet under the surface, loosens and makes fine all the soil. Young trees will make great strides if they are so planted.

"The dynamiting can be done in orchards or about trees of *any age*. If done rightly, it will accomplish the work without breaking or tearing away any roots, leaving the soil in condition to give the roots twice the feeding-ground they had before and providing perfect drainage and water-storing capacity. The use of dynamite is the secret of success in growing fruit by mulching systems without so much plow and harrow tillage."

From the chapter on "Cultivation":

"It is necessary to break up the subsoil, whether there is hardpan or not. The dynamite method usually is the cheapest at any time, and it is the only way by which the work can be done thoroughly after trees have been planted.

"Dynamite is the thing with which to dig holes for new trees, to break up the whole soil three or four feet deep every few years, and to help renovate old orchards, because it will do these things more cheaply and better than they can be done by any other means. If you have fruit trees, which seem to be standing still and which do not bear, no matter how big they are, properly explode a charge in the soil around or between them, and the trees will likely get to work. In a bearing orchard, a proper charge midway between trees is always safe and is generally very effective."

From the chapter on "When Trees Will Not Bear":

" Explode three or four charges of dynamite a few feet away from each tree. Mulch the surface with a thick covering of vegetable matter, or by keeping a couple inches of dust under the tree. Feed with commercial fertilizer."

From the chapter on "Grapes":

"Vines are heavy feeders. Their roots extend far out and make a network in the soil. The proper distance to plant will be from six to eight feet apart, although sometimes this can be changed to advantage. Strong varieties, on fertile soil, need more room than small growers on poor soil. Before planting is done, the ground should be worked even more thoroughly and deeply than for a tree. Remember that you are planting something which will last a generation, not a crop to be removed in a season or two. Plow the land, use dynamite to dig the holes, and have a clearance inside the hole of at least twenty inches."

Trees Planted With Red Cross Grow 50% Better

NIAGARA RIVER NURSERIES AND FRUIT FARM.

YOUNGSTOWN, N. Y., November 27, 1911.

The trees planted April 23, 1910, with dynamite did so nicely that during the spring of 1911 we planted several hundred trees in holes dug with dynamite and in every case the trees so planted grew and made one-half more growth than trees planted in the usual way.

We think so well of the process that we shall plant all of our trees during the spring of 1912 with dynamite.

On our soil, which is a very hard hardpan, we can dig the holes for one-half the cost of digging with spade. We now feel confident that the shattering of the soil is a great advantage. Last season was the dryest ever known in this section and yet our trees where holes were dug by dynamite kept green and grew right along. I think we will get a better and deeper root system.

We used only one-third of a stick for peach trees and that gave us a fine hole 2 feet deep and a good breadth. We stake our ground out, drive a hole where the stake stood, insert the charge and the work is done in an instant. One man can keep a fair gang busy following up and putting in the trees.

HENRY LUTTS.

General Advice on Tree Planting

Setting Trees with Dynamite to Conserve Moisture

ARTHUR E. COLE, Prop., High Point Farm and Nursery, Chamblee, Ga.

Over a large portion of our country is a hardpan of shale or tight clay near the surface. It is a menace to the productiveness of trees and all vegetables which root deeply. The scientific principle involved is the inability of such a subsoil to absorb, retain and give back to growing crops the essential moisture. On such land the water soaking through a thin topsoil fails to penetrate and finds a second drainage on this subsurface, draining off in "Wet Weather Springs" or standing in surface suspense as "Bogs." Land in this physical condition fails of an agricultural dividend. Put in proper physical condition this same land becomes highly profitable. The way to proceed is by using dynamite. Probably no process of plowing known to agriculture can produce the good results in breaking up a tight subsoil that does this blasting with Du Pont Dynamite.

Planters of clover and alfalfa realize this. Orchardists have come to accept it as final. Strawberries and all crops requiring a great amount of moisture respond to its use in a way almost unbelievable. Short lived crops like tomatoes and cucumbers will continue to bear through the long season where the hills are shot with cartridges of dynamite. Figs produce a crop the first year after being set where dynamited. The writer can see this from his back door as he writes. This new-found process is the foundation of a new era in agriculture and horticulture.

At the present time many thousands of trees are being set in young orchards all over the United States. Such a boom in apple and pecan planting was never before known. It is a logical answer to an unsupplied demand. The question is, will these orchards endure—will they pay?

In orchard setting, the use of dynamite is advised in practically all soils. The pecan naturally flourishes on the deep, moist, alluvial soil of river and creek bottoms. Nature has put it where it will not suffer from drought in the long, hot, dry summer and autumn through which it must hold and mature its late fruit. We can move it to our grove or back yard and succeed with it by dynamiting the ground.

Watermelons and peaches should be dynamited because they require great moisture, being fruits composed largely of water, but of all fruits demanding an unfailing and continuous supply of moisture the apple and pecan lead. Therefore, it is imperative that we dynamite as an artificial means of conserving the moisture. Unlike all other fruit, the apple grows on the end of a twig of new wood, a twig which bears no more. The apple being a biennial, sets its fruit bud for next year during July and August of this year. So we see this hard condition imposed: a winter apple must make its new growth of wood, hold its foliage, mature its present crop of fruit, and, if it is to produce again next year, the little tender twig bearing an apple must mature a new fruit spur or twig alongside of it to bring forth a healthy fruit bud next year. And all this during a long, hot summer or autumn. The demand for moisture is enormous.

What if the tree is shallow set? What if the roots trail along close to the dry surface? What if the tree is on a dry ridge or hillside baked by the summer sun? What if on thin land, starved for both fertility and moisture? The answer may be total failure or partial failure and short lived trees, or a partial crop, or a crop only every other year, or a large per cent. of drops, or defoliated trees. READER! Observe and mark well. Your orchard dividend and its future success is in balance when you *set* your orchard. Remember you can never set it over the second time. No amount of regrets can retrieve a mistake made in the setting. You will spend much money bringing your orchard to a high standard by the allotted time for it to begin to bear, but no amount of money expended in after years can correct a mistake at planting time. You may have in mind plowing out a deep furrow for your row, but remember that that furrow can never be plowed again, and the root system will be influenced to confine its growth to the small amount of pulverized soil. Holes may be dug, broad and deep, but like a large plant in a small pot, the hard walls of the hole when filled with roots will cramp or turn back or callous. Either of these methods will be found wanting.

The new and eminently successful mode of land preparation for all fruit or ornamental trees and for many field or garden crops, especially in tight, dry soils, is by blasting holes with half cartridge of Red Cross Extra Dynamite or blasting the furrow with a like amount at intervals of 15 to 20 feet. If in a large orchard or a large field, a blasting machine may be used to detonate the charges. If only a few trees are to be set, the blasting should be done with fuse and blasting caps. Let the depth of the holes for setting your cartridges be governed by the state of the soil. Make a hole with auger, sharpened wood dibber, or crowbar well down into the subsoil. Tamp well with moist clay. For the best results, throw out a bushel or more of the clay that has been broken by the shot and fill with some organic matter that will slowly decompose as the years go by, mixing and cutting in well with a sharp shovel or spade. Leaf mold, woods topsoil, fence corner settlings, old bones, scrapings from under an old house or outhouse or any such matter is good. Now the roots can go down and out in an area broken and pulverized for many feet on all sides. The tree will make a rapid and healthy growth and come to bearing earlier and live many years longer. It will produce fruit annually, more fruit, larger fruit and fruit of better color because of the conserved moisture. It will resist drouth. The much talked of "insect resisting tree" is a tree healthy and vigorous enough to overcome their baneful attack.

The writer set an apple orchard last winter, using Red Cross Dynamite, in an area where woolly aphis is known to abound; but not a single evidence of their presence has been noted.

The winter, spring and summer just past is one of the dryest on record for Georgia. Many trees, in fact a large per cent. of trees, set by the ordinary method have died. But in three orchards set by the writer with dynamite, 100% are living and doing well. As a neighboring nursery man expressed it, "These trees didn't know it had not rained."

Wanted Proofs and Got Them

A subscriber to the "Rural New Yorker" wrote the editor of the paper the following letter:

Dynamiting for Planting Fruit Trees

What information can you give as to the use of dynamite for planting fruit trees? I expect to set out quite a few this Spring, and am wondering if it would be the thing to use on my land, which has a shallow topsoil, about 18 inches of gravelly subsoil, underneath which is a very hard, clay hardpan. The dynamite makers claim great things for their product. I would like to hear what others have to say who have used it.

Connecticut. J. W. M.

R. N. Y.—We want actual experience about this if we can get it.

In an issue of the *Rural New Yorker*, published two weeks later, the following letters from subscribers were published in answer to J. W. M.'s inquiry:

Dynamiting in Tree Planting

In answer to J. W. M., page 126, in a block of seven-year-old apple trees, about a dozen failed to make a good growth, and one of them died when four years old. Replanting, the tree failed to live through the Summer. The soil is Hagerstown shale loam, and we found the shale very near the surface in this place. Before planting the third time we used about one-third stick of dynamite (say three ounces), making the hole with a bar and putting the charge about two feet under surface. The result was a mass of fine shale of about a cubic yard in extent. The tree was planted and grew and made a good growth, although the season was very dry. J. W. M. would have to get well into that hardpan with his dynamite and use more of it, say one-half pound. I think the cost would be justified in the better drainage secured, as unbroken hardpan within two feet of the surface would hardly be an ideal condition for an apple orchard.

Pennsylvania. A. T. B.

I planted 150 trees with dynamite with the best success; they make a much quicker growth. They will grow in two years as much as the old way will in three years. If the soil is very hard digging, it will be found much cheaper.

Massachusetts. C. M. O.

J. W. M., Connecticut, wants actual experience in dynamiting holes for fruit trees. I tried that last Spring for over 100 peach trees in heavy clay subsoil on land that would raise scarcely more than 20 bushels of corn to the acre. I used an iron rock drill and drilled down about three feet, and used one-third stick 40 per cent. dynamite. The dynamite fuse and caps cost about four cents per tree, which I think is a very cheap way of digging the holes, as all I did after I shot the holes was to shovel out a few shovelfuls and set the tree. As last season was very dry with us the trees made good growth; they were headed back to about 18 inches from the ground and about five-eighths inch in diameter when set, and now they will average seven feet tall and most of them will average two inches in diameter, and some larger than that. This ground was in corn the season before, and the patch was set in straw and tended up to September. One of my neighbors set peach trees last Spring in the spade-dug system and those trees made very little growth. We have a man near New Albany, Ind., who runs a commercial orchard system; he has been trying it 12 years and I heard him say he would set no trees without dynamiting, thinking it paid largely. From what experience I have had and seen from others I would certainly try dynamite, for it certainly tears up the subsoil and gives those roots a chance to go down to moisture, and dry as the season was, I never lost a single tree out of 104, which I think is very good.

R. F. T. BORDEN.

In the Spring of 1911 I set 52 apple trees in filling in an old orchard where the trees had died. First tried one-fourth pound, but found that too heavy a charge as it made too large a hole; then used one-sixth pound charge. First I bored in about 12 to 15 inches, pushed the stick clear to the bottom, tamped it well and let it go. We could set a tree in the hole easily in five minutes, one holding the tree and treading in the dirt as the other shoveled. Not having enough dynamite, two holes were dug with shovel. Result, one of those trees died and only one of those set in holes that were dynamited. The soil is a sandy loam underlaid by sand rock about three feet below the surface. All trees were heavily mulched with straw early in the season before the drought began. Some of the trees made a new growth of more than two feet on each limb, while the tree set in the dug hole made a growth of three to six inches. An observation of the trees is proof conclusive that it paid to use the dynamite. The trees set were two years old.

Ohio. H.

We are using dynamite here for setting grape roots, and it is a good thing for clay or hardpan; do not think that it would do any good in mellow or gravel soil. It would be necessary to get the dynamite down in the clay and to tamp the ground down hard around the dynamite before firing the fuse; the explosion then would loosen the ground in all directions, and would enable the root system to extend more quickly.

Hammondsport, N. Y. J. W.

Last Spring in preparing for planting fruit trees I decided to use dynamite, which was so entirely successful I shall give you my method. For making the holes I used a heavy iron bar, sinking it from 20 to 24 inches, using one-quarter stick dynamite, pulverized, then after placing cap and fuse tamped wet earth into hole. This would loosen the ground four or five feet deep and about four feet on each side, in ordinary freestone soil with heavy yellow clay subsoil. My trees made larger growth last year, where other trees in the neighborhood which were dug in made very small growth or died from the dry weather. Care should be taken to pack soil well around trees when put in. Cost of material for shooting holes was five cents each, not including labor.

Seebert, W. Va. W. M. I.

Du Pont Editor's Note.—Neither the inquirer nor endorsers were known to us.

15-Year Test Proves Value of Dynamite in Tree Planting

Fig. 56 shows a Valencia orange tree, now 20 feet high, planted with dynamite, Jan., 1896, in grove of E. C. Franzen, Santa Ana, Calif. Fig. 58 shows same kind of tree, now less than 10 feet high, planted same time with spade in same orchard, both trees having received the same treatment since then. Fig. 57 shows Mr. Franzen standing in a blasted treehole in his orange grove.

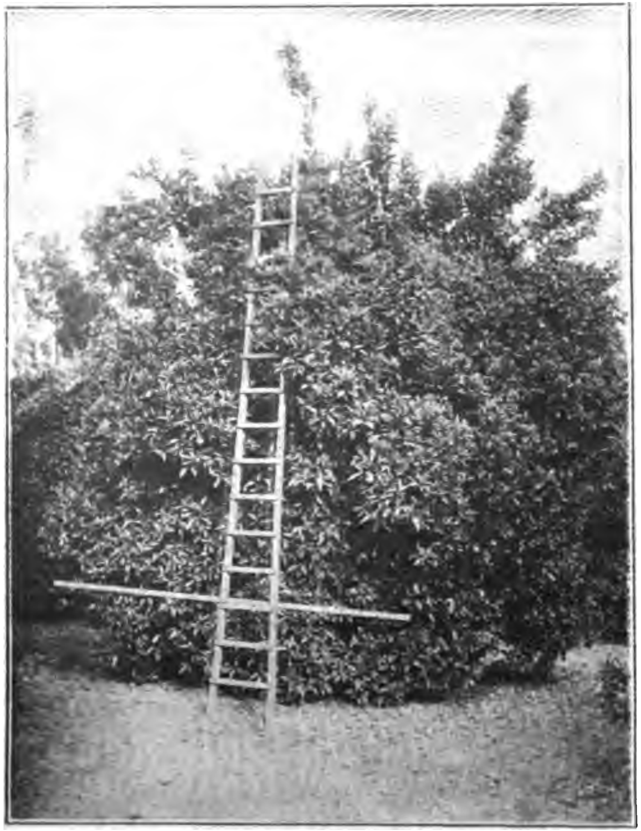


FIG. 56

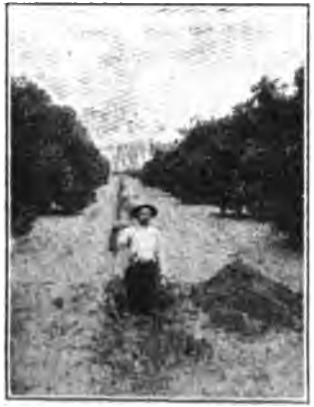


FIG. 57

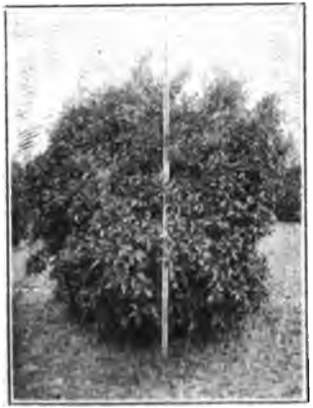


FIG. 58

Deep Plowing or Subsoiling With Red Cross Dynamite Increases All Crops

The value of Red Cross Dynamite in the orchard has been proved beyond question.

Let us now consider its value in the production of the vegetables and grains that constitute our chief farm products.

Of course a tree is merely a plant or form of vegetation and the process of soil preparation which will benefit an apple tree will benefit a corn stalk, or a head of cabbage, or a tomato plant, or any other form of vegetation which draws its sustenance from the soil through its roots. With the exception that different plants feed upon different plant foods, the principles of their growth and life are the same in all forms of vegetation.

But we are not obliged to go by theory or opinion. In the following pages we prove by actual photographs and incontrovertible testimony that deep plowing with Red Cross Dynamite increases the growth and fruition of corn, tomatoes, beans, grapes and watermelons, oats, alfalfa, flowers and cotton.

The almost universal condition of farm land throughout this country is that it will not grow good crops unless extensively fertilized, deeply plowed and the crops rotated carefully.

In spite of all these efforts to keep the topsoil rich and productive, the average yield per acre of all standard crops is steadily decreasing.

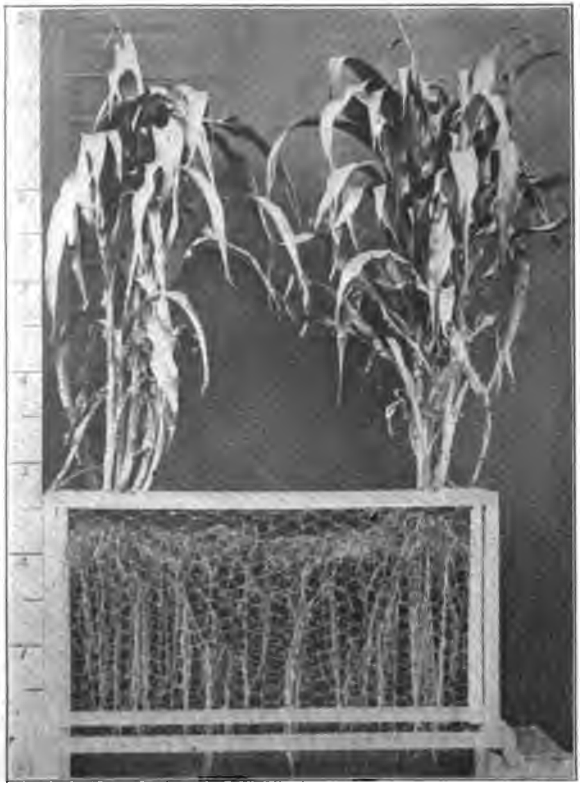
For generations and for centuries the top layer of our soil has been cultivated to a plow depth of four to eight inches. The same soil has been turned over, year after year, and gradually robbed of its natural, original fertility.

Deep plowing is, in most cases, the remedy for soil deterioration. When done with a subsoil plow to a depth of sixteen to eighteen inches, there is a noticeable increase in yields. When done with Red Cross Dynamite to a depth of five to six feet there is a phenomenal increase in yields.

Why Deep Plowing Increases Fertility

The reason why deep tillage or subsoil plowing is desirable is that all the soil below the bottom of the ordinary plow cut, in other words everything below six to eight inches, is still in its primeval condition. It has never been disturbed. Chemical analyses of soils down to a depth of twenty feet show that on the average acre there are tons of plant foods which become available only when roots can penetrate to them, or when ascending moisture brings them up to the roots that cannot get down.

Alfalfa and other deep rooted plants are called "soil makers" because they penetrate this compact soil, introduce humus and provide a passageway for the descent and ascent of water which carries with it the soluble, fertilizing elements, but many subsoils are so hard that it is practically impossible for any one plant to penetrate them.



If it costs the value of twenty bushels of corn to raise and market an acre of corn, you are doubling your profits by increasing the yield from 25 bushels to 30 bushels or from 40 bushels to 60 bushels.

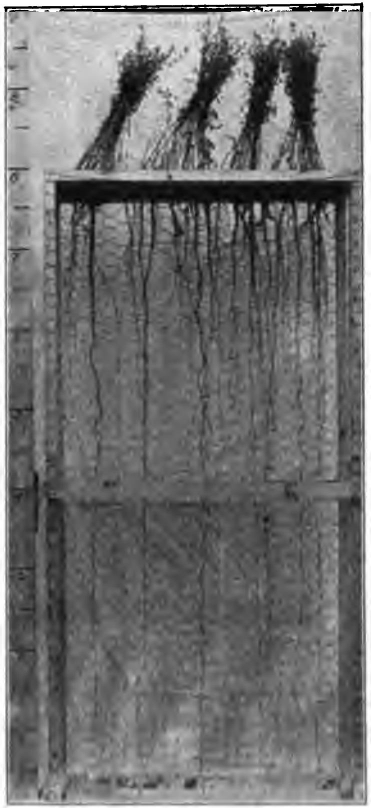


FIG. 62 SHOWING HOW CORN AND ALFALFA ROOTS GO DOWN INTO SUBSOIL FIG. 63

Photos made by Prof. Ten Eyck, Kansas Experiment Station

Even when this is possible there is no use in putting such a burden on the plant, because whatever vitality is expended in making its own home beneath the surface is subtracted from the vitality of the plant above the surface. In other words, the plant that has to fight for its life beneath the soil has little energy left for fruition.

If we make root growth easy and quick by breaking up the subsoil, then we make the fertilizing elements of the subsoil immediately available and save the energy of the plant for fruition. We also create in the subsoil a porous condition favorable to the storage of water at a depth that will not keep the soil cold, and yet near enough to the roots to feed them through capillary attraction. Subsoiling also introduces air into the soil, and it is just as necessary for the roots of a plant to have air as it is for a human being to have air.

Now it is obvious that the passage of air and moisture through the soil, the growth of roots and the resulting deposit of humus, all tend to keep the soil open, hence if it is once thoroughly shattered with Red Cross Dynamite to a depth of five or six feet and the principles of crop rotation are followed thereafter, it is safe to say that that subsoil will never again get back into its primeval compact condition. Whether or not it remains as open as immediately after blasting, depends on the continuity of cropping and the proper rotation of the crops.

The effect of subsoiling virtually is to change a farm from a six-inch layer of topsoil to a six-foot layer. The only element of fertility lacking in the lower five and a half feet is humus and that will be increased by each year's deep rooting crops. The significance of this conclusion must be appreciated by any careful agriculturist, because it means a tremendous increase in available fertility and a practical means of insurance against drouth.

Extracts from United States Government Bulletins:

The advantages of removing water downward through the soil instead of over the surface may be briefly stated as follows:

"The surface soil is retained entire instead of the finest and most fertile parts being carried off with every considerable rainfall.

Any plant food in manure or other fertilizer deposited upon the soil is carried into it with the water as it percolates downward from the surface, and so becomes thoroughly incorporated with the soil.

Rain water as it passes through the soil serves a most useful purpose by dissolving and preparing crude soil material for the nutrition of plants.

The soil having been well prepared, is at all times during the growing season in readiness for the growth of plants, such growth not being hindered by stagnant water or saturation.

The frost goes out earlier in spring so that the planting season opens one or two weeks sooner than in the case of poorly drained soils.

Where stiff clays are found, the soil is made more porous, open and friable, and roots penetrate more deeply than they do with surface-drained soils.

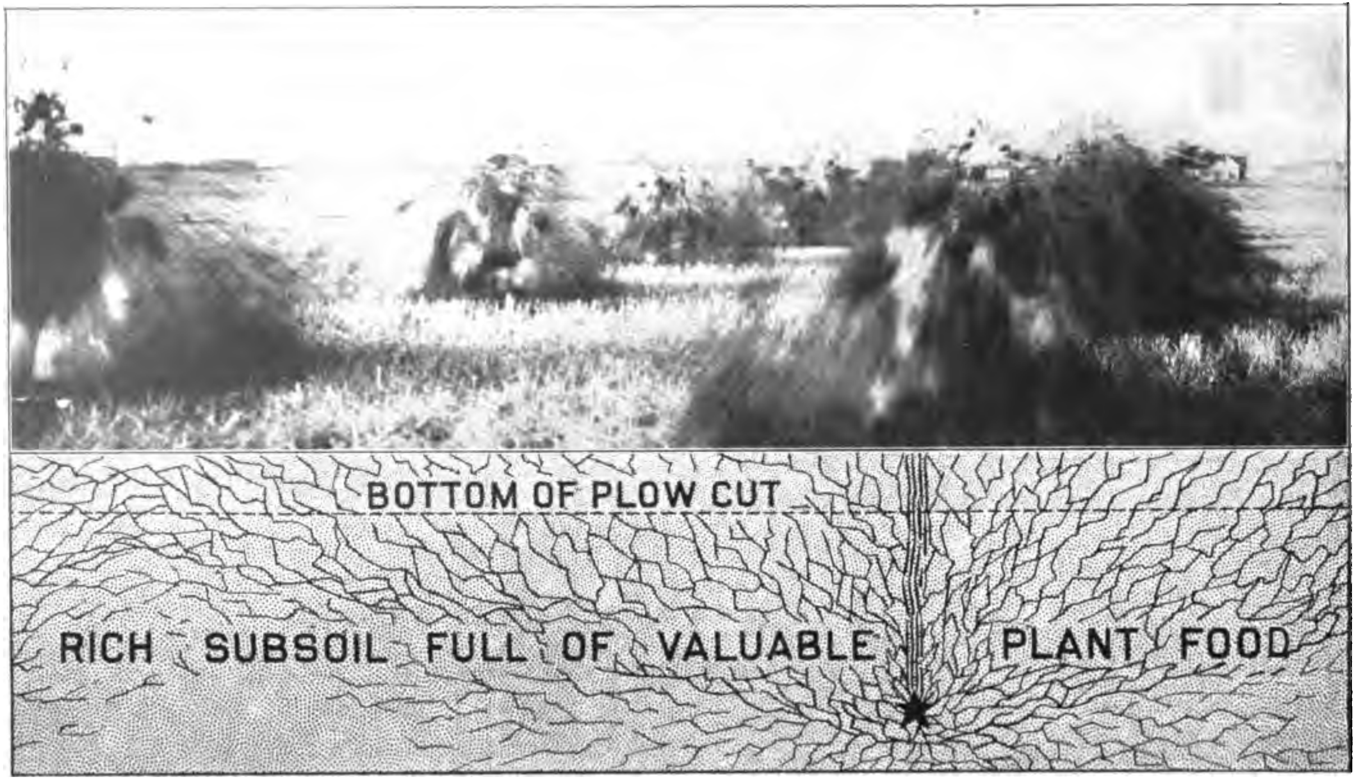


FIG. 64.—DYNAMITING SUBSOIL—NOTE DEPTH OF PLOWED SOIL AND THE RICH SUBSOIL FULL OF VALUABLE PLANT FOOD

The effects of drouth are diminished owing to the large and deepened soil bed and the more favorable condition of the surface for preventing excessive evaporation of moisture.

It aids in making new soil out of the unprepared elements since it permits a free entrance of air and amtospheric heat, which disintegrates soil material hitherto unavailable for use of plants."

Depth of Root Penetration

Much misapprehension exists among agriculturists regarding the depth to which roots penetrate the soil. It is a general belief that the roots of cultivated crops do not reach to a greater depth than one or two feet.

Corn roots have been found to penetrate four feet deep and to fully occupy the soil to that depth. On drier and deeper soils they went as deep as eight feet. Roots of small grains, such as wheat, oats and barley, penetrated the soil from four to eight feet and even ten feet in depth. Perennial grasses have been found to go to a depth of four feet the first year and five and a half feet the next year, and they probably go considerably deeper during succeeding years.

Other crops have gone to the following depths: Potatoes, three feet; sugar beets, four feet; alfalfa, thirty to fifty feet. The buffalo berry penetrated the soil to the depth of fifty feet in Nebraska. In California, grape vines went down twenty-two feet; flagwort more than ten feet; goose foot, eleven feet, and hop plant, eight to ten feet.

Most of the above results were obtained in humid or sub-humid regions. Soils and climate differ in such a way as to favor a somewhat deeper root penetration in arid regions, hence it is natural to expect to find roots at even greater depths than the above.

The conditions which encourage deeper rooting are drainage, limited supply of moisture and a soil porous and fertile to a great depth. Deep, early cultivation also forces roots to seek the lower depths. Deep rooted plants are much more drouth resistant, due to the lower water supply during periods of drouth. They also have a larger feeding area, and the fertility of the soil is not depleted so quickly.

Subsoiling With Red Cross Dynamite

This is the ideal method for breaking up compact subsoil whether this compactness is due to plow sole or natural hardpan, because it breaks up the compact subsoil without throwing the subsoil on top of the topsoil or mixing the two.

The objection to mixing virgin subsoil with old topsoil is that the former contains very little humus and unless heavily fertilized is disadvantageous as a topsoil until one or two years after it has been broken up, when the action of air and moisture and the penetration of roots and other vegetable matter shall have nitrated it.

The method of subsoiling with Red Cross Dynamite is very simple. In the average soil not underlaid with extremely tough hardpan, holes one and one-half inches in diameter are put down every fifteen feet to a depth of about thirty inches. These holes may be made with a dirt auger or subsoil bar, or a churn drill may be obtained from any blacksmith which will put down the holes very easily in average soil.

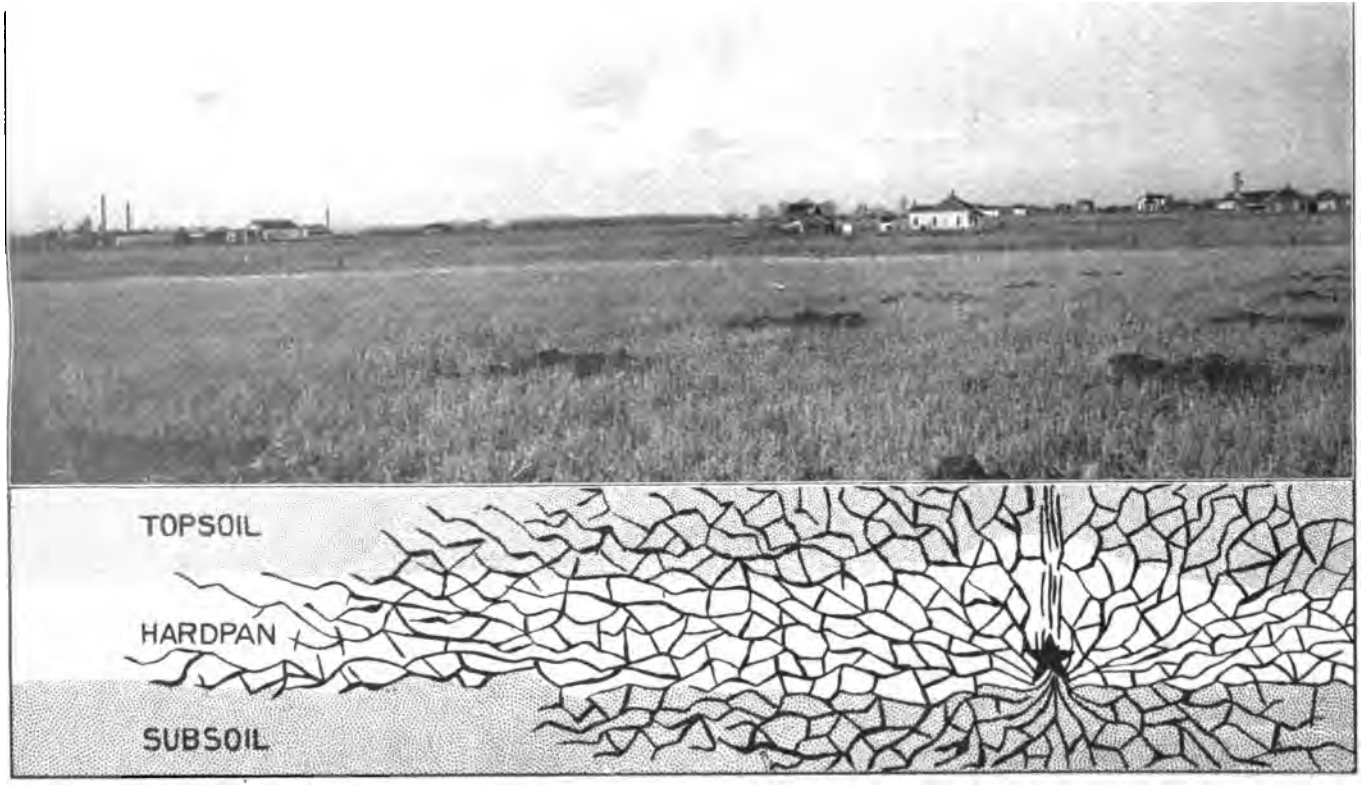


FIG. 65.—KANSAS HARDPAN BLASTED WITH RED CROSS DYNAMITE—WITH SECTIONAL VIEW OF SOIL

Each of these holes is then charged with a half cartridge of 20 per cent Red Cross Dynamite, which has previously been primed with a No. 6 Du Pont cap crimped on to about three feet of fuse, the length of the fuse required being enough to reach to the top of the ground. Each hole must then be tamped with a wooden tamping stick, using moist earth or clay for this purpose. The tamping must be done thoroughly, as the object of the blast is to crack and shake up the subsoil sideways and downwards rather than to blow the subsoil up into the air. *For this reason, subsoiling should be done only when the ground is dry, because when it is wet the blast is almost certain to blow upwards and make a hole in the ground instead of breaking it up sideways.*

After a considerable number of holes have been charged the blaster passes from one hole to another, lighting the fuses; the explosions follow about one minute after the fuse is lit. As the charge is usually effective principally underground it is not necessary for the blaster to keep any great distance away from the explosions.

Firing the charges electrically has advantages, the chief of which is that all the blasts over a large area covered by twenty or thirty holes may be fired at one time and the shaking and cracking effect of the various charges is greater because of this united action. This method is, however, more expensive.

Another advantage is that there is much less liability of a misfire, which may occur when the cap and fuse method is used, because the cap may pull out of the cartridge after it is lowered into the hole. This seldom happens when an electric fuze is used.

Detailed instructions for preparing and loading subsoil charges for both methods of blasting will be found on pages 119 to 126.

Method of Breaking Up Hardpan:

A large part of the farms of this country are underlaid with a natural hardpan of clay which is completely impervious to water and which lies from ten to forty inches beneath the surface. Such a hardpan is a constant menace to crops. It prevents the storage of moisture and causes the topsoil to wash away in wet weather and dry out quickly in dry weather. Where the ground is level such a hardpan will cause pools of water to form in fields in wet weather which drowns out the vegetation. This hardpan must be broken before good crops can be raised on such land.

When subsoiling under such conditions the exact location of the charge must be determined by the depth of the hardpan. The holes should be placed so that the cartridge is imbedded in the hardpan. When the hardpan is very near the surface the holes should be about thirty inches in depth, but if the hardpan is very tough the holes should not be as far apart as fifteen feet. It is rarely necessary to put them closer than ten feet.

Where the top of the hardpan is from thirty to forty inches below the surface it is necessary to bore the holes deeper so as to locate the cartridge in the hardpan. With the hardpan reaching to within thirty inches of the surface, for instance, and a charge placed in a thirty-six

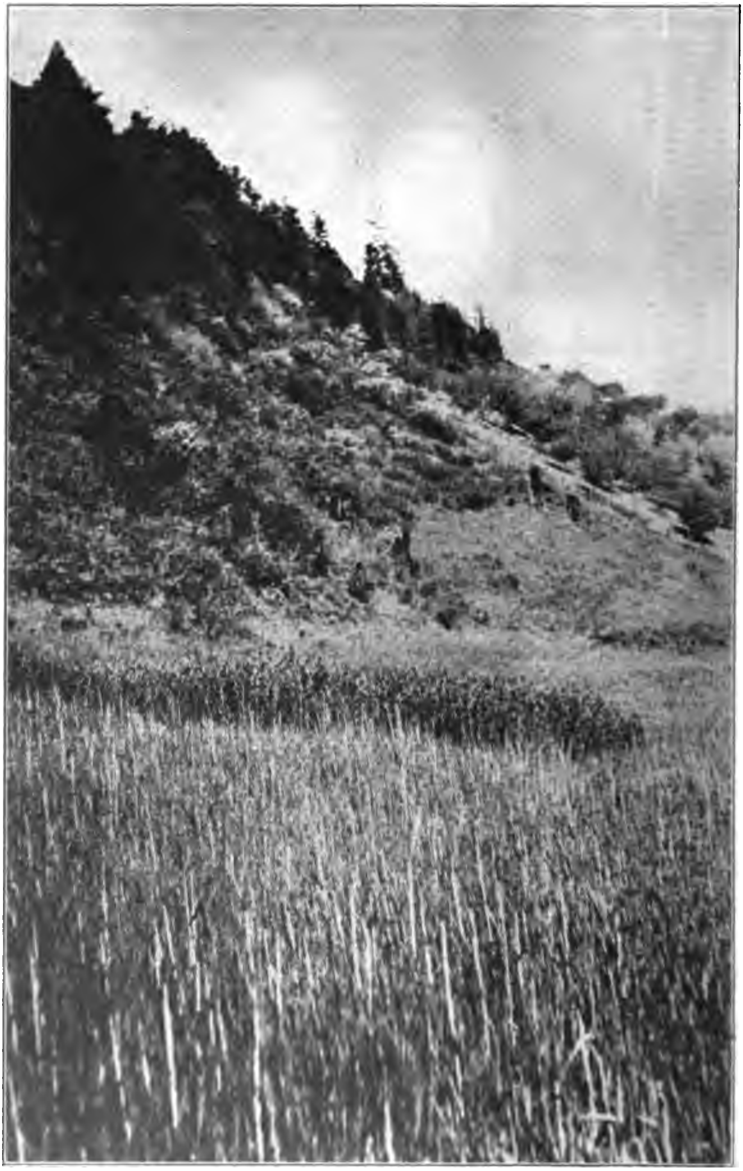


FIG. 66.—NOVEL PROOF OF VALUE OF SUBSOILING

Above view shows a California oatfield recently cleared of stumps. Wherever a stump had been blown out, the oats grew a foot higher, as shown by the dark streak. The same blast that threw out the stump broke up the subsoil underneath it. In regular subsoiling, the effect is broader because the charge is confined underground.

We are in receipt of a letter from Mr. Bud Lane, of Hope, Indiana, who has done blasting for a number of years. In his letter he tells of an experience he had with a farmer.

He blasted, for this farmer, a field of stumps; payment for this work was not to be made until three months later. When Mr. Lane called to obtain settlement the farmer claimed that the number of stumps for which he asked payment was too great. Mr. Lane said that he could prove that his estimate was true, but the farmer thought that impossible as the field was sown in wheat. They went out to the field, and on each spot where a stump had been blown out the wheat was several inches higher than in places which had not been affected by the blasting. Mr. Lane very easily proved his point in this way.

inch hole and well tamped in, the hardpan will be broken to a depth of six or seven feet from the surface and sideways six or seven feet in all directions. Under these conditions holes at fifteen feet centers will probably be close enough because of the considerable volume of loose compact soil above the hardpan.

As hardpan frequently runs under the surface soil irregularly, the depth of the holes will have to be varied to suit the conditions in different parts of the field that is being subsoiled. The man putting down the holes can easily decide the necessary depth by the amount of resistance that the soil offers to the auger or bar.

The main thing to guard against is the location of a charge beneath a thin section of hardpan, as such a charge may break up the soil underneath the hardpan but may not break the hardpan. When the hardpan is thin it is better to place the charge a little too high than a little too low.

In parts of California and in a few other sections of the country, the hardpan is so thick and hard as to have the characteristics of stone. In such soil the charge should never be less than a whole cartridge at fifteen-foot spacing, and owing to the high cost of putting down the holes, it is often more economical to use twenty-foot spacing with two or three cartridges per hole. The high value of California land when under cultivation warrants the high cost of such subsoiling.

In rocky hardpan running near the surface a whole cartridge every ten feet will probably produce better results than four cartridges every twenty feet. While the holes for ten-foot spacing need not be quite so deep as for twenty-foot spacing there will be four times as many holes.

Opinion of a Distinguished Citizen

A pioneer in subsoiling with dynamite was General Samuel J. Crawford, ex-Governor of Kansas. Below is a letter from him that tells of his experience:

> "I am glad the good work of blasting the compact subsoil and hardpan is moving along in the east as well as in the west, whether it be for the planting of trees, grain or anything else that grows from the ground. If the subsoil is loosened so that the rainfall can penetrate the earth, the roots of grain, grasses, trees, etc., will follow the water to their natural depth and draw their nourishment from five or six feet of soil instead of five or six inches of surface soil, as heretofore. Besides, the blasting creates sub-reservoirs in which to store the surplus rainfall which will supply the roots of the growing products with moisture when the dry season is on. Again, if the ground is loosened so the water can pass down into sub-reservoirs, there will be no standing water on the surface to damage the crops or keep the farmers back with their work. Such treatment, properly applied, will revolutionize the agricultural and horticultural industries throughout the country.
>
> "The government is spending millions of money for irrigation purposes in isolated places, which, from the nature of things can only benefit a few people, while the blasting process will benefit all the farmers and fruit growers at comparatively a nominal expense. By this process most of the worn-out farms in New England and throughout the country can be reclaimed and made to produce good crops. All that is necessary is for the producers to grasp the idea and learn how to handle explosives."

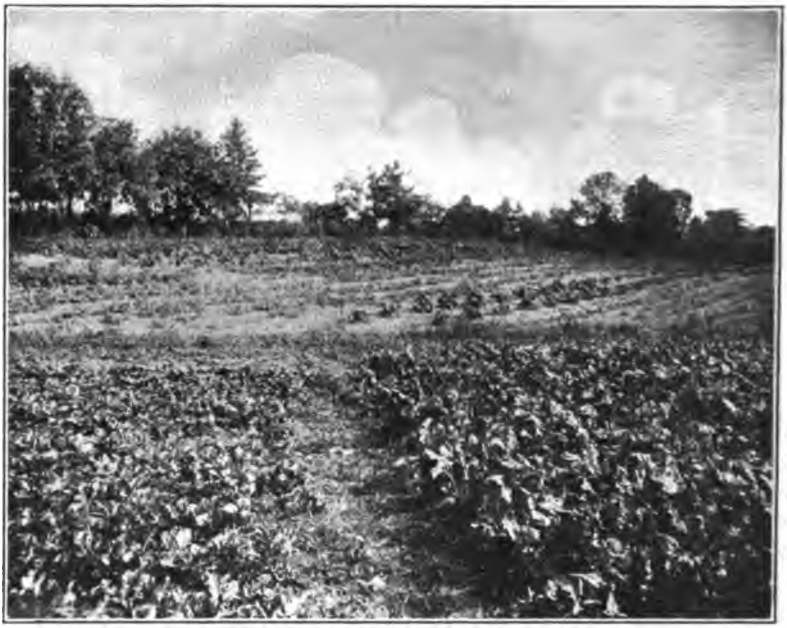


FIG. 67

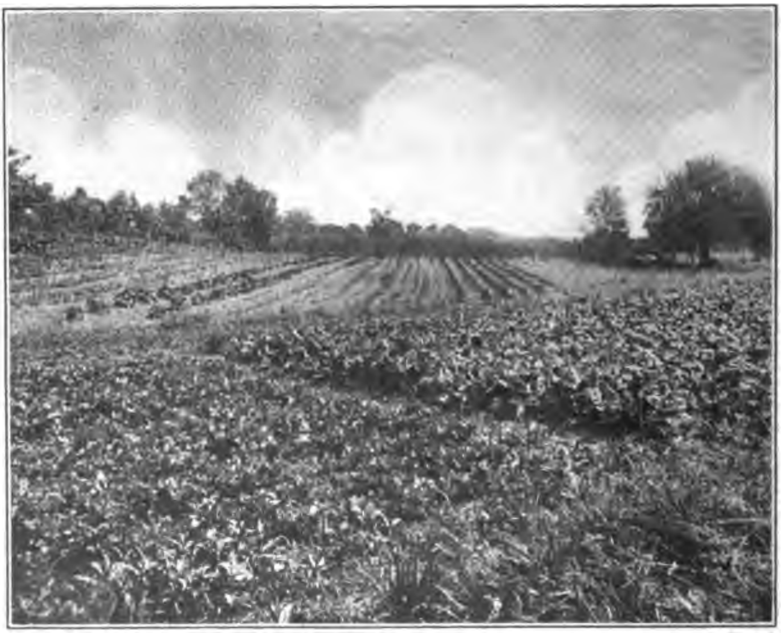


FIG. 68

Both cuts are photos showing two plots of garden beets, the ones to the right planted on ground subsoiled with Red Cross Extra Dynamite ten days after those on the left were planted on ground not subsoiled. The dynamited beets matured very early and brought 75 cents per dozen bunches, the others were much later and brought only 40 cents per dozen bunches. Farm of H. B. Decker, E. Stroudsburg, Pa.

Cost of Subsoiling With Red Cross Dynamite

The following table will give an approximate idea of the cost of subsoiling, referring to the cost of materials only:

SPACING	CHARGE	Number of holes per acre	Lbs. Red Cross Extra 20% Dynamite	Number of No. 6 (red label) blasting caps per acre	Number of feet of fuse per acre in 3-ft. holes	Approx. cost per acre of materials for dynamiting 3 feet below surface
15	½	194	49	194	582	12.20
18	½	128	32	128	384	8.00
	1	128	64	128	384	11.20
20	½	109	28	109	327	6.93
	1	109	55	109	327	10.98

The labor cost will of course depend on the wages paid and the ease or difficulty with which the holes are put down. Where very tough hardpan is encountered the cost of putting down the holes may amount to nearly the cost of the explosives and supplies. On the other hand, where only a plow sole is encountered the holes can be put down very rapidly and cheaply, and for that reason these tables do not include labor cost.

Where soil conditions are easy the holes can be put down at the rate of about thirty per hour. Where soil conditions are difficult it may take five minutes or more per hole. Priming the cartridges and tamping them in will take from two to three minutes per hole. In general, subsoiling will seldom cost less than $10.00 an acre and will rarely cost more than $25.00 an acre.

Second Year Results Greater Than First

ANDERSON, S. C., September 23, 1912.

In reference to breaking land with dynamite for farming purposes will say that the land so broken in the Spring of 1911 shows a greater improvement than it did the first year. The upland corn was at least 40% better than the corn raised on adjoining land that was not dynamited. I dynamited four acres this year and I find a great difference in the corn compared with the adjoining land. The greatest difference, as stated above, is the second year. I also broke some land for cotton late in the spring this year and I am much pleased with the results, as the cotton is still green and blooming and has stood the dry weather better than the other land.

Yours very truly,

J. S. FOWLER.

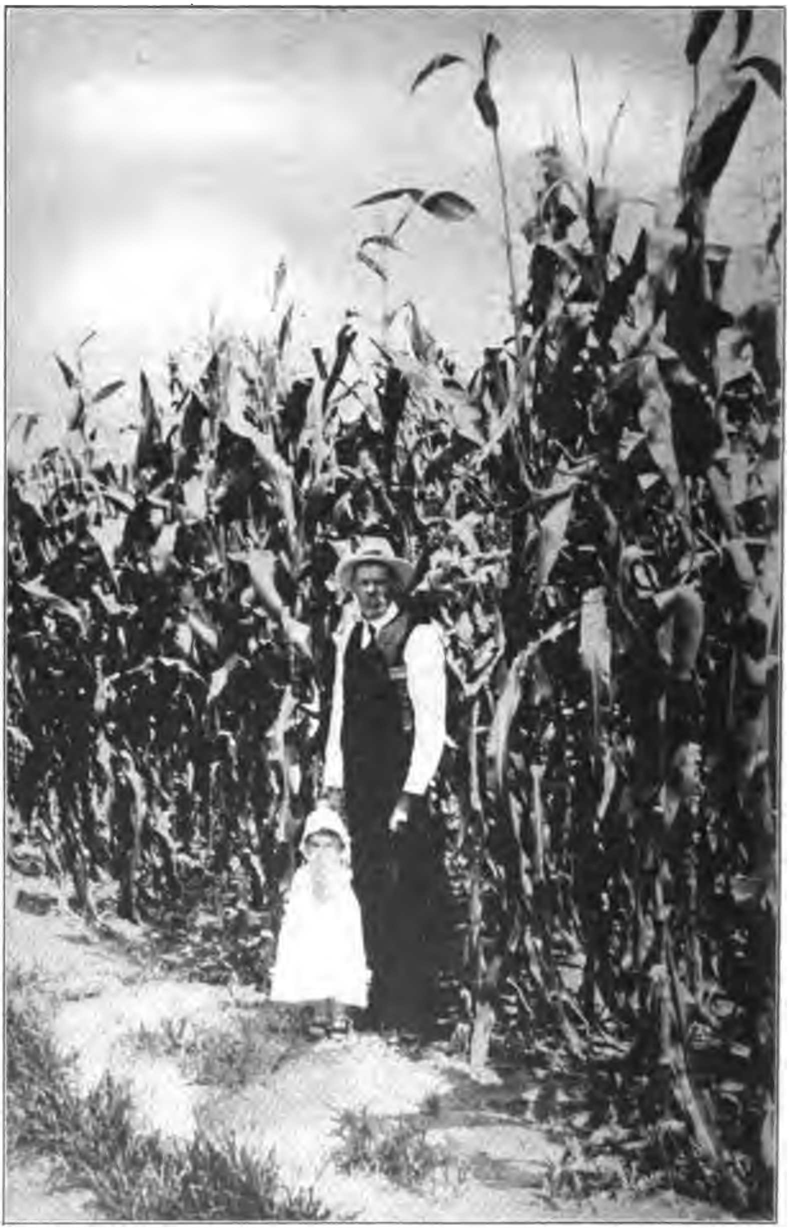


FIG. 69.—DEEP PLOWING MAKES BIG CORN YIELDS

One of the first experimenters with dynamite for deep plowing was J. H. Caldwell, of Spartanburg, S. C. He subsoiled a portion of his corn-field with dynamite and increased the yield one-third over that of the portions not subsoiled. A committee of the Chamber of Commerce of Spartanburg inspected this corn and certified to the accuracy of the figures.

Effects of Subsoiling With Red Cross Dynamite on the Action of Commercial Fertilizers

Commercial fertilizers are ordinarily added to the soil in a very fine and readily soluble condition, and are usually incorporated with the first few inches of soil at or just before the time of seeding. This keeps them from being carried further into the soil mass through cultivation. During heavy rains when there is a considerable amount of surface run-off of the excess of water, large parts of the fertilizers thus added are at once brought into solution and lost by being carried away by the surface drainage. The fertilizing elements can, however, be carried into the deeper soils by transfusion through the soil moisture or they can be carried down with percolating water, provided the subsoil has been made sufficiently porous to permit of such percolation. Where soils are at all packed both of these processes are materially hindered, but can be relieved by a thorough breaking to a sufficient depth. Except in very rare instances these troubles occur beyond the reach of the plow and Red Cross Dynamite becomes necessary.

Thus subsoiling with dynamite will result in an enormous decrease in the loss of fertilizers by washing and also in inducing a deeper development of roots in search of foods, the importance of which is already so thoroughly understood by those now interested in promotion of deep subsoiling.

The use of a large amount of fertilizer is largely handicapped by even a short season of drouth. During the spring, when the soils contain large amounts of moisture, heavy applications of fertilizers result at once in a very luxuriant growth of succulent but shallow-rooted vegetation. A plant thus developed is poorly able to combat dry soil conditions. Deep subsoiling done in connection with such heavy applications of fertilizers naturally brings about a much better soil moisture condition. This, of course, permits of very vigorous and rapid growth during the spring both above and below the surface. It also safeguards the plants against the dry summer.

For the proper development of a plant certain foods and conditions are necessary. If one of the foods is lacking or deficient in amount, the growth of the plant will correspond with the amount of this food available, and will not be influenced beyond this point by excess of other foods present. Water is, of course, one of the essential foods, so when additional foods are added as in chemical fertilizers it becomes necessary to furnish the plant with more water.

Farming Menaced by Loss of Water

Has Been Lowered Almost Two Feet a Decade, Expert's Report Shows

WASHINGTON, March 29.

The ground water of the United States, upon which the agricultural wealth of the country depends, is lowering at the rate of nearly two feet a decade, according to Prof. W. J. McGee, soil and water expert of the Department of Agriculture. He arrived at this conclusion from reports from 35,000 different points in the United States, covering every county.

Unless means are taken to check the constant lowering, dire results from drought and failure of crops are likely to ensue, declared Professor McGee.

Investigation has shown that freshets and floods are allowed to carry off a large percentage of the rainfall from lands where it should be retained. Intensive farmers near large cities, whose land is worth $400 or $500 an acre, Professor McGee says, take pains to keep every drop of water that falls on their land from leaving it.—From Philadelphia North American.

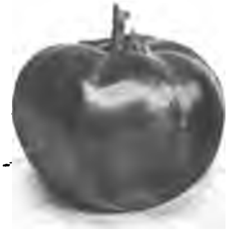


FIG. 70
GROWN ON SOIL NOT
DYNAMITED
AVERAGE WEIGHT 6 OZS.

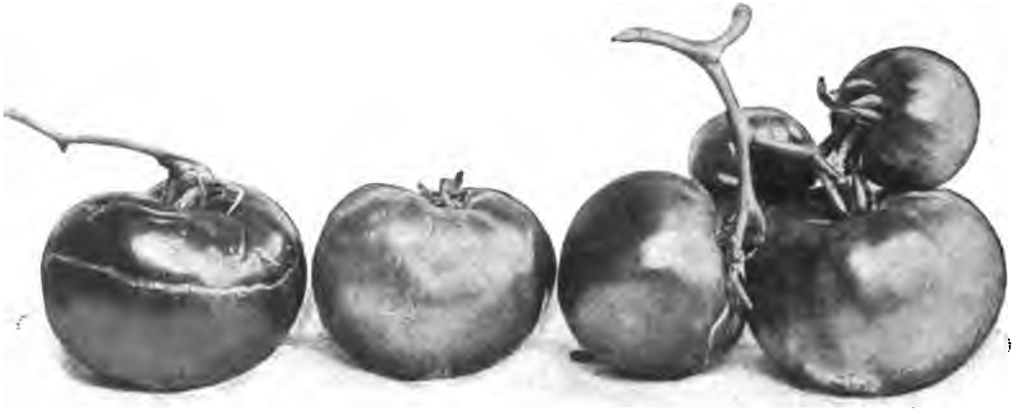


FIG. 71
THESE TOMATOES GROWN ON DYNAMITED SOIL. AVERAGE WEIGHT 10 OZS.
BOTH FROM SAME SEED AND IN SAME LOCALITY

DYNAMITED SUBSOIL OF A GARDEN PLOT RESPONSIBLE FOR THE LARGE, LUSCIOUS TOMATOES SHOWN AT RIGHT OF PICTURE

E. I. du Pont de Nemours Powder Co., Wilmington, Del. Haddonfield, N. J., September 5, 1911.

Gentlemen:—Referring to the photograph of tomatoes sent to you. These were grown on a plot about 10 x 20 feet, subsoiled with a third of a cartridge of Red Cross Extra Dynamite in each of four holes. The charge was 3½ feet below the surface and was fired by a blasting machine. No. 6 Victor Electric Fuzes were used. This plot has a top layer of soil about 2 inches deep of red gravel composition.

The tomatoes in the picture were photographed July 29, 1911. August 15, tomatoes were ripe; about the 20th I picked some weighing from 8 to 12 ounces. Today, September 5, 1911, the vines are still growing with various sizes of green tomatoes. There are some blossoms now and I will have tomatoes until frost.

A friend had some tomato plants same as mine, all the seed from the same tomato. He has a good garden, but his tomato vines produced much smaller fruit, clearly proving the advantages of dynamiting subsoil for crops in garden or field.

Yours very truly,
L. Z. LAWRENCE.

Experience in Terracing

From "St. Louis Star Farmer," Feb. 23, 1912.

Editor, "The Weekly Star Farmer:"

Land that has washed down the hill, down the branch and down the river is gone, and gone forever. Wherever the top soil is thin and sandy, a tight clay lying close to the surface and the country hilly or rolling, washing is sure to follow. The precious and friendly raindrops, like fire, are a good servant, but a bad master. If allowed to wash away all the top soil, with its plant food, they become man's worst enemy.

In the four years I have occupied my present place I have not suffered the loss of one foot of top soil from washing, and my land is hilly. I solved the problem with dynamite. At the same time I solved several other vastly important problems—the conservation of moisture, destruction of insects, and fine, porous pulverizing of soil for cultivation.

It is terracing with dynamite that we are now considering. To do this, make a land level of three pieces of scantling or any cheap, rough, straight-edge stuff; one for your bench to be 8 to 12 feet long and two pieces of equal length 2½ to 3½ feet long. At a hardware store buy a 75-cent carpenter's spirit level. Secure it on top of bench in the middle by ten-penny nails partly driven. A more simple and accurate device could not be imagined; but if you prefer, buy a land level for $10 or $15. Two men can level fifty or more acres a day. One takes the level and one follows with a hoe, chopping out a hoeful of dirt at each end, thus indicating your terraces. Or a man may follow with turn plow or twister, discarding hoe. Throw several deep furrows up for terrace. Now, with a number of 1½-inch iron drills follow in last furrow and drill holes 24 to 34 inches deep, every 10 to 14 feet. Insert a half stick of Red Cross Extra 25% Dynamite, equipped with cap and fuse. Tamp well with an old broom handle or other wood tamp, light at first and gradually harder and harder till hole is filled. Use clay for tamping. Split end of fuse to effect a powderpan; turn back and light a row at a time with a torch or matches. Use your best judgment in spacing terraces, according to steepness of your grade. Much land may be saved for cultivation by dynamiting close terraces alone, and only throwing every third or fourth one up with plow. It is marvelous how this will hold hilly land together. Save your fresh land and reclaim that has begun to wash. Besides being the best means for terracing, you will literally irrigate your farm with these storehouses of moisture and will be astonished beyond measure at the ease of cultivation and crop returns.

I travel all over the Southern states from time to time, meeting nurserymen and orchardists. I have never yet seen a man who had used dynamite for stump blowing, tree setting, subsoiling or ditching who was disappointed with results. For my part, I use it for all these purposes on my place. It has more than proven its worth.

ARTHUR E. COLE,

High Point Farm and Nursery, DeKalb Co., Ga.

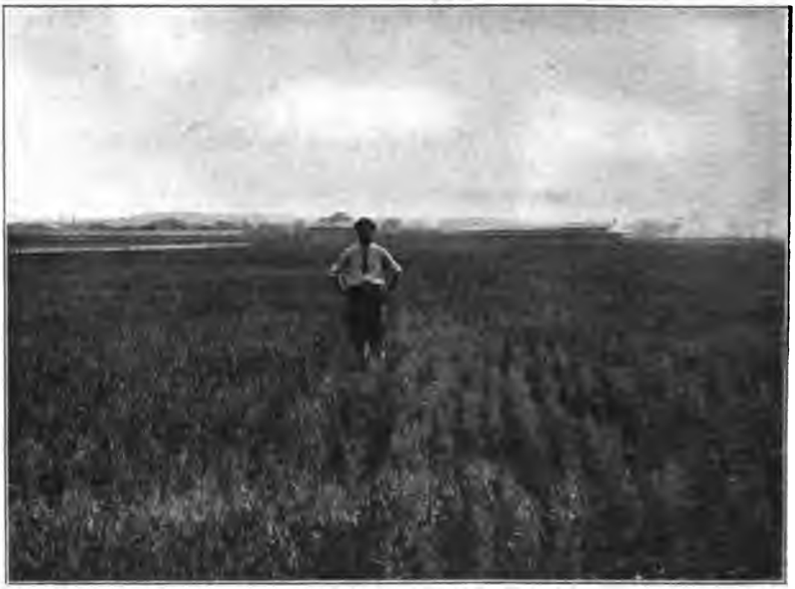


FIG. 72
OATS GROWN ON N. Y. STATE FAIR GROUNDS AT SYRACUSE ON GROUNDS NOT PLOWED WITH DYNAMITE. NOTE THIN ROWS, SHORT STALKS AND POOR HEADS

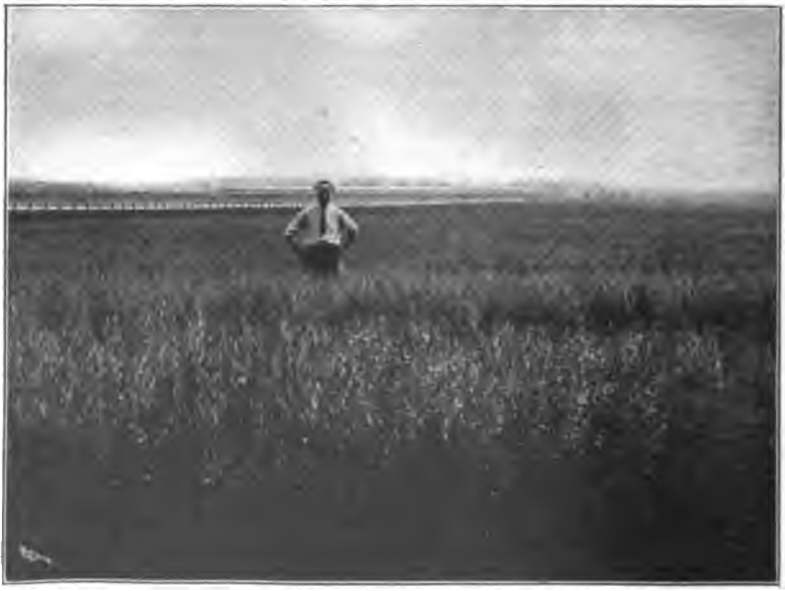


FIG. 73
OATS GROWN ALONGSIDE OF CROP IN UPPER PICTURE BUT ON GROUND DEEP-PLOWED WITH DYNAMITE. NOTE HEIGHT, VIGOROUS GROWTH AND WELL DEVELOPED HEADS

Remarkable Results Achieved on Barren Ground by Dynamiting Subsoil on Farm of Agricultural Experimental Station, Clarksville, Tenn.

(See cut on page 76)

Under date of August 16, 1911, Mr. S. L. Smith, Superintendent of City Schools, Clarksville, Tenn., writes as follows regarding "Subsoiling with dynamite":

"During December, 1910, I subsoiled one acre of ground on the Experiment Farm here which is run under the direction of the Agricultural Department of the joint High Schools, which ground before that time had produced nothing for several years. It was 'worn-out' land. This subsoiling cost about $12.00 per acre, but as compared with the excellent results obtained, I consider that it has paid us well.

"The corn shown on the left of the photograph which I sent you is on the dynamited ground. That on the right of the same photograph represents corn planted and cultivated in the ordinary way without any scientific methods—no subsoiling. No fertilizer used on either the subsoiled or unsubsoiled ground, but well cultivated. Otherwise, the land not subsoiled was considered better than that subsoiled.

"Both acres were planted the same day and the subsoiled land will yield possibly three times as much as that not subsoiled. In fact, it is the best corn in the county, and all the farmers of the county who have seen it realize there is something in scientific farming. We selected the poorest land we could find, and it is my intention to subsoil more ground this fall."

A Director of Agriculture Convinced

SACRAMENTO VALLEY IRRIGATION COMPANY.

During the past week your Messrs. Jones and Doremus have given the farmers of Glenn County a very fine demonstration of the use of dynamite in farming.

There is no question but that hundreds of pounds of your Red Cross Dynamite will be used here during the next year as a result of the work of your representatives.

While there is no hardpan through this section of the west side of the Sacramento Valley, the loosening up of a big body of soil in land where trees are to be planted will give the tree roots a perfect environment for growth and development, and be of great value. The opening up of lands that have been pastured when wet and otherwise abused will be accomplished by the use of dynamite in a very effective manner. Your work here is appreciated.

W. S. GUILFORD,
Director of Agriculture.

Duration of Subsoiling With Red Cross Dynamite

The publicity given to these astonishing results which point to a revolution in farming methods, has naturally created much inquiry in the minds of the farmers as to the cost of subsoiling and the length of time before subsoiled land will have to be again subsoiled in order to keep it open.

The cost averages about $15.00 an acre, including dynamite, blasting caps, fuse and the labor of making the holes and doing the blasting. In most cases the cost is recovered within the year, out of the increased yield, but in other cases where the increased yield would not be worth more than $15.00 an acre, it is important to know how long this increased production is going to keep up so as to justify the expense.

Let us first consider the matter from a theoretical point of view.

One of the first uses of dynamite for subsoiling was in tree planting. Twenty-one years ago W. R. Gunnis planted an orchard with dynamite at La Mesa, Cal. This orchard matured more rapidly than orchards set out with a spade, resisting drouth and other unfavorable conditions with marked success, and although the tract has been subdivided and used as a residence property, some of the trees are still thriving and for years this orchard was recognized as the most productive and best appearing in the neighborhood.

W. W. Stevens, Orchardist, Mayfield, Ga., planted trees with dynamite eighteen or twenty years ago. He says:

> "They are the finest trees I have ever seen grow for their age. In the planting of peach trees I gained two years in six; in other words, I got as much fruit from a tree planted with dynamite at four years old as we usually get at six years old. I not only plant them with it, but where a tree is failing and seems to be on the decline, I start it off to growing again by firing charges from three to ten feet apart. Nothing seems to tickle the earth so much as planting watermelons after explosion of dynamite from three to four feet under ground."

Mr. James Craig, President of the Rose Cliff Farm, Waynesboro, Va., began planting trees with dynamite nine years ago. He writes under date November 15, 1911—

> "I should think from the thoroughness of the work done by dynamite that it will last fifteen or twenty years without question."

Mr. Craig plants all his trees with dynamite.

Mr. Arthur E. Cole, Proprietor of High Point Farm, a small-fruit nursery at Chamblee, Ga., writes as follows under date of November 17, 1911—

> "About eight years ago the New Roswell Road was graded. In the cut through the steep hill just south of Nancy Creek, between the eight and nine-mile post (from Atlanta), much blasting was done. A vigorous growth of clover and young sycamore trees immediately sprang up on the roadside where this blasting was done. The clover seed found their own way from the hay where the mules were fed, into the porous soil where the dynamite was used. A good stand has appeared each succeeding year without any cultivation. Noticing this I began to observe rock quarries and other places where explosives had been used, and found similar conditions prevailing. Wherever the ground has been broken with dynamite a perfect system of subsoiling results. Cut a cake of butter with a sharp knife; the cut surface is left hard and smooth. Just so in subsoiling with a plow. It rains, the water soaks through topsoil

and then follows the course of the plow, soaking no further. But in subsoiling with dynamite exactly the opposite condition prevails. The ground is 'heaved,' shaken and broken many feet deep, and is left so open and porous that all the rainfall is absorbed and retained. This is given back as growing crops demand. Subsoiling with Du Pont Red Cross Dynamite has now become a common practice with farmers and orchardists. This process has the double advantage of *irrigating* and *draining both at one time*. Each place where a cartridge is discharged becomes an underground reservoir, and if thus broken in squares of ten to fourteen feet, with one-third to one-half stick of Red Cross 20 per cent., the ground will be sufficiently broken for drainage from hole to hole as a result. Perhaps the most valuable feature of subsoiling with dynamite is the lasting effects. Modern machinery can plow our ground very fast, but the work is not permanent, while in dynamited land the good effects are *underneath* and not affected by sun or wind and the porous condition *remains for years*. Of course the length of time varies with different soils and different crops and different modes of cultivation—limestone soil remaining open longest. Once the land is well subsoiled with dynamite and leguminous crops, peas, alfalfa, clover or rye are sown, thus feeding nitrogen deep into the soil from the air through the roots, a porous subsoil may be expected for from three to four years from one dynamiting. Of course it is not necessary to keep these particular crops growing continuously, but a good idea is to rotate, using one of them every second or third year. Last spring I dynamited some tree holes on my place, spaced about twenty-five feet. About mid-summer when everything was dry as a crisp from severe drought I decided to plant vegetables in the same rows with the young trees, between these dynamited holes. It was a test case and no cultivation was given, except one hoeing. The results were wonderful. I not only had vegetables, but they continued to bear till frost. It is evident that in the clay belt of middle Georgia, progressive farmers will all of them soon resort to subsoiling with dynamite. It is faster, more simple, less expensive and far less dangerous than often supposed to be. The public is invited to come at any time and see my apple trees, one year old, that have put on new growth of from five to seven feet in one year. They were planted last spring (consider the dry year), in holes blasted with half stick of Du Pont Dynamite."

J. H. Baird, Supt. of the famous Hale Georgia Orchard Company, Fort Valley, Ga., operating the largest peach orchard in the world, writes under date of November 16, 1911.

"We have been subsoiling with dynamite for tree planting for three years; the results have been very satisfactory indeed. Just how long the benefit of breaking this hardpan will last is a problem. Our first dynamiting three years ago shows up splendidly on our trees and up to this time they are much in advance of those not dynamited. I should think at least one year. I believe the results in subsoiling in this manner will last eight to ten years, and it is my intention now to use dynamite in our old orchards at their very first appearance of 'going back.' I am sorry that I cannot give you more information on this line, but my experience with dynamite, as stated above, is only three years old. All agriculturists know that in order to get greater yields the land has to be broken deeply and the new way of doing things is to cultivate less land and grow more per acre. Will certainly bring your product more in use each year."

See also pages 87 and 97.

Increased Wheat Yield 25%

Extract from letter of Mr. D. A. Beamer, manager, Missouri Immigration Association, Lamar, Mo., dated August 2, 1911:

"The writer, on his own account, dynamited about three acres two years ago. The present season it carried a crop of wheat which was sown last fall. This three acres was part of a ten-acre field, and was decidedly the wettest and least productive part prior to the dynamiting.

"The wheat on this dynamited ground was treated exactly like the balance of the ten acres of which it is a part, and the wheat on the dynamited portion was at least 25 per cent. better than the balance on the ten-acre plot.

"As a result of my experience, I will subsoil ten acres of land this fall because the very first crop taken from the above three acres has shown a good profit on the cost of subsoiling."

Subsoiling a Success on I. H. C. Demonstration Farm

INTERNATIONAL HARVESTER COMPANY OF AMERICA.
W. K. WOOD, MANAGER. W. A. RENN, SUPERINTENDENT.
BROOKHAVEN, MISS., September 11, 1912.

DU PONT POWDER Co., Wilmington, Del.

Gentlemen.—As requested I am sending under separate cover four views, one each of cotton and corn, not subsoiled and one of each subsoiled.

You will note the great difference, and we will subsoil more extensively the coming year.

Yours truly,
W. A. RENN.

Subsoiling a Success in Europe

February 13, 1912.

I thought you might be interested to know that while a student at the Tokay Agricultural School at Tokay, Austria-Hungary, I subsoiled three acres of ground with dynamite prior to planting grape vines. The ground was in a very steep hillside and practically covered with shale rock. The dynamite broke up the ground and made it porous, and it is conservative to say that the vines planted in this way produced 50 per cent. more than those adjacent planted in the ordinary way.

Yours truly,
ALEX RICHTER,
Highland, Arkansas.

The Best Time to Subsoil

Subsoiling with Red Cross Dynamite should be done only when the soil is dry—preferably immediately after harvest. Wheat or other cereal crops are usually harvested early in summer. The field may then be subsoiled under ideal conditions in July or August. Ground bearing corn, potatoes, hops, or other late maturing crops, should be subsoiled in September, October or November—as soon as the crop is off. Spring subsoiling is not advisable unless the soil is quite dry and when good rains may be expected soon after.

Get What You Pay For

The strength of all Du Pont dynamites is shown on the cartridges and cases with the exception of our Permissible Explosives and explosives having strengths of 20 per cent. or less. We guarantee the strength marking on cartridges and cases to be correct.

Anyone using dynamite the strength of which is not marked is probably getting less than the represented strength and is therefore paying too high a price for what he buys. Inferior goods, you know, can be sold at lower prices than standard manufactures.

HOW TO TRANSPORT, STORE, AND USE

✚ RED CROSS ✚ DYNAMITE

DO NOT TRY TO
USE DYNAMITE
UNTIL YOU HAVE
CAREFULLY READ
THIS SECTION

FIG. 83

FIG. 84

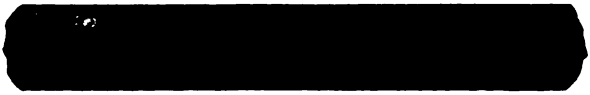


FIG. 85

TABLE SHOWING THE AGRICULTURAL WORK IN WHICH THE USE OF DYNAMITE WILL SAVE MONEY AND TIME, AND THE MOST SUITABLE BRAND AND STRENGTH OF DYNMITE FOR IT.

Kind of Work.	Brand and Strength of Explosive.
Boulder Blasting	Red Cross Extra Dynamite 40% to 60% strength
Cellar and Foundation Excavating	Red Cross Extra Dynamite 20% to 40% strength
Ditching	Red Cross Extra Dynamite 20% to 40% strength Du Pont N. G. Dynamite 60% strength
Fruit Tree Planting and Cultivating	Red Cross Extra Dynamite 20% strength
Hardpan or Subsoil Blasting	Red Cross Extra Dynamite 20% to 40% strength
Log Splitting	Red Cross Extra Dynamite 20% strength Du Pont Blasting Powder
Log or Ice Jam Starting	Red Cross Extra Dynamite 40% strength
Pole or Post Hole Digging	Red Cross Extra Dynamite 40% strength
Road Grading	Red Cross Extra Dynamite 20% to 40% strength
Swamp Draining	Red Cross Extra Dynamite 40% strength
Stump Blasting	Red Cross Extra Dynamite 40% strength
Tree Felling	Red Cross Extra Dynamite 40% strength
Well Sinking	Red Cross Extra Dynamite 40% strength

Explosives

Explosives are solids or liquids which can be changed almost instantaneously by a spark, great heat or powerful shock into gases having many times the volume of the explosive in its original form. Coal and wood are changed slowly into large volumes of gas by burning; water is changed into a large volume of gas (steam) by heating it. This is the whole theory of explosives and much in their use, which would otherwise seem difficult to explain, is easily understood if this theory be borne in mind.

Blasting explosives are divided into two classes, namely: High Explosives and Low Explosives. High Explosives are more commonly known as "dynamite," including all of those explosives which can be properly detonated only by means of an intermediate agent such as a blasting cap or electric fuze and not by simple ignition. Blasting powders are classified as low explosives and are exploded by a spark.

Blasting Powder

Blasting Powder is black and is produced in granulations or grains of various sizes. It is packed in bulk in steel kegs containing twenty-five pounds. Although it is invaluable for many kinds of coal mine, quarry and general excavating, it is not generally applicable to any blasting about the farm except for splitting logs as described on page 137.

Dynamite

Dynamite differs from blasting powder in that it detonates with much greater rapidity and has a greater shattering effect. The most important properties which contribute to the effect of dynamite are *strength or disruptive power and quickness or shattering power.* The other principal factors in the usefulness of dynamite are its stability or keeping qualities and such qualities as may tend to make it safer to handle. These essentials can only be secured and maintained by the employment of the highest quality of ingredients, greatest care and attention, expensive and complicated machinery, skillful labor and supervision, long experience, and continued tests. The Du Pont Company fulfills all of these requirements. It has been engaged in the explosive manufacturing business since 1802, has factories in all parts of the United States and no other manufacturing concern in this country maintains a greater number of technical chemists than are engaged at the Du Pont laboratories, who test daily the output of the factories to prevent deviation from standards, and constantly study and experiment with explosives in order to improve them.

Furthermore, a corps of experts in the use of explosives is maintained, not only to study the exact requirements of explosives in the various fields and differing conditions, but to demonstrate their qualities, action and method of using them.

The Du Pont Company manufactures numerous kinds of dynamite, each having some particular property which makes it different from any other kind. Almost every kind is made in different strengths. Some kinds will burn if a spark falls on them and all kinds can be burned if put in a fire. *Don't, therefore, leave dynamite where it can be ignited any way, because, when hot it is very sensitive and often explodes.*

Red Cross Dynamite, the Agricultural Explosive

The Du Pont Company manufactures a special brand which is named "Red Cross Extra Dynamite," and is especially adapted to farming purposes. It is a mixture of nitroglycerin and other explosives with an absorbent which renders the compound less sensitive to shock and more safely used and transported than ordinary dynamite.

Red Cross Dynamite explodes with great power, shattering or excavating anything which is in the immediate vicinity. Its general appearance and consistency is similar to damp sawdust, and it is placed on the market in paper-covered cartridges 8 inches long and of different diameters, the standard being 1¼ inches. The cartridges are packed in cases containing 25 pounds or 50 pounds.

Safe Handling of Dynamite

There is a popular misconception of dynamite in the public mind. Newspapers in reporting outrages such as bomb throwing by anarchists, safe cracking "jobs" by burglars, etc., incorrectly report them as perpetrated with "Dynamite." The result is an erroneous, widespread impression that a dynamite cartridge will explode if dropped on the ground or thrown against the body of a person.

As a matter of fact, safe breakers and bomb throwers do not use dynamite cartridges at all; they would not be suitable for their purpose because it is so difficult to explode them. What these criminals use as a rule is nitro-glycerin. This dangerous explosive is used commercially for shooting oil wells, etc.

True there is a certain proportion of nitro-glycerin in dynamite cartridges, but the dangerous explosive is scientifically compounded with wood meal and some other ingredients in such a way that it can be absolutely depended upon not to explode accidentally if our simple and plain instructions for its use are complied with.

One of the safest of explosives manufactured by the Du Pont Powder Company is Red Cross Extra Dynamite, which is especially recommended for agricultural purposes. This brand of dynamite, in practice, is detonated by the powerful shock of an exploding blasting cap or electric fuze, the strongest cap or fuze being necessary because this dynamite is so insensitive.

Responsible people can use and handle dynamite just as safely as they can handle gasoline, matches, or coal oil. The energy of dynamite can be directed in the work to which it is adapted as well as the energy of steam can be directed in the work for which it is used.

Prompt Removal From Freight Station

The law requires prompt removal of all high explosives from freight stations. Hence farmers expecting shipment of dynamite or blasting caps should arrange with the freight agent or station master to notify them immediately on arrival of shipment, which should be removed within 24 hours.

Hauling

When transporting explosives by team always keep the wagon boxes thoroughly swept out, and when using an open wagon protect the load from sparks, rain, etc., with a canvas covering. Store the cases of explosives so that they will *not* shift and *never* haul detonators and explosives together.

Handling and Storing

When dynamite is handled with bare hands, it nearly always causes a headache. Old gloves should therefore always be worn when using it, and they should be destroyed and clean ones provided, before they become damp and sticky. A pair of gloves will remain in good condition for a long time if the dynamite is handled carefully.

Du Pont Red Cross Dynamite is not so sensitive to shock that it is likely to explode from a slight jar. It is made just as insensitive as is practicable so that it is much safer to handle and use than ordinary dynamite, and this is why a strong detonator is necessary to explode it properly. Nevertheless it should be handled sensibly and carefully and only by responsible persons.

Dynamite and detonators should not be hauled together from the dealer's or the railroad station. The detonators do not weigh much, and can be brought along on some other trip. If blasting caps are purchased from a dealer in the tin boxes separate from the wooden shipping case, it is a good plan to put these boxes in a basket or wooden box with a horse blanket, coat, hay or anything else that would keep them from being roughly jarred and shaken on the way home. As soon as explosives are received they should be stored in a dry, properly ventilated building, which will not be likely to be set on fire or shot into, and far enough away from dwellings or roads to prevent loss of life if they were to be exploded accidentally. They should be kept under lock and key and where children or irresponsible persons cannot get at them. If large quantities are to be stored for some time, a dry, well-ventilated, fire-proof and bullet-proof magazine, located in an out of the way place should be provided. Fuse, wire, thawing kettles and blasting machines may be stored in the same building with the dynamite, but blasting caps and electric fuzes *must never be stored* in the same building, because they are more easily exploded than dynamite, and it would be possible to explode them accidentally by a hard shock or jar which would not explode dynamite. If detonators were to explode by themselves, they would be unlikely to do much damage unless there were a great many of them, but if they were to explode in the same room with dynamite, they would probably cause the dynamite to explode too, and this might do very serious damage.

Opening Cases

When ready to use the dynamite, open the box or case with a hardwood wedge and a mallet, and take to the work, in a dry box or pail, the number of cartridges required immediately. Never take more than the day's supply even in warm weather, and in cold weather, take only what can be kept thawed until it is to be used, unless there are arrangements for keeping it thawed where the blasting is to be done. Let somebody else carry the tamping stick, fuse, and detonators, to the work. As soon as holes are ready for the dynamite—and when possible the holes should all be ready before the dynamite is brought to the work—the priming, charging, tamping and firing should be carried on as rapidly as possible without becoming careless.

A very little practice will put you in the way of doing blasting quickly, systematically and economically, and you will wonder how you ever got along without dynamite.

Thawing

Some kinds of dynamite freeze at about 50 degrees Fahrenheit and will not explode at all, or only imperfectly, when in that condition. Even when chilled they cannot be depended on to work well. Red Cross Dynamite is an exception to this rule, for it will not freeze until the weather is quite cold. When dynamite is frozen it must be thawed, or if chilled it must be warmed before using. Frozen dynamite is easily recognized because it is hard and rigid.

If, after the thawed dynamite is ready to use, something causes a delay and it becomes chilled or frozen before it can be put into the bore-hole, it should be thawed or warmed again. It does *not* harm dynamite *to thaw it many times,* provided this is done in the right way.

Red Cross Dynamite, if loaded in the ground below the frost line and properly tamped, will not freeze again, but other dynamite may chill or freeze almost immediately when loaded in cold ground, which makes it necessary to detonate it immediately after charging. It is this that makes Red Cross Dynamite so valuable in cold weather.

The best way to thaw dynamite, and to keep it thawed until it is to be used, is in a thawing kettle made for the purpose. Dynamite may be thawed by leaving it spread out on a shelf in a warm room (not in a dwelling) over night, or by burying it, while in the case, in manure. It may also be thawed by putting it in a covered, water-tight pail and hanging this pail in warm water and it may be carried to the work in any kind of dry bucket or box if covered with an old coat, a piece of blanket or something of the kind to keep it warm. It is exceedingly dangerous to try to thaw dynamite in front of an open fire, or in hot sand, or on hot stones, or metal or steam pipes, or in an oven, and it is in attempting to thaw dynamite in some of these ways that accidents frequently happen. Do not attempt to thaw dynamite by putting the cartridges in hot water or by turning a jet of steam on it.

The Catasauqua Thawing Kettle is made in one piece with an outside jacket for the hot water all around the dynamite section. The No. 1 size holds 30 pounds of dynamite and the No. 2 size 60 pounds.

The water must never be heated in the Catasauqua Kettle, but must be heated in some other vessel, and when not too hot to burn the hand, poured into the water compartment provided the dynamite compartment is empty. It is dangerous to heat the water in the Catasauqua Kettle even when the dynamite section is empty, because there may be a little nitroglycerin in it which has soaked out of the dynamite previously thawed. Dynamite should not be put into the thawing kettles without first carefully wiping out the dynamite compartment clean and dry.

Do not place a thawing kettle over a fire while it contains dynamite.

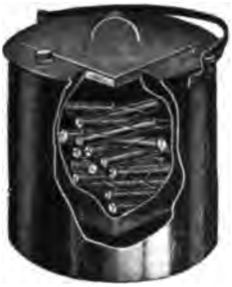


FIG. 86.—CATASAUQUA THAWING KETTLE

Du Pont Blasting Caps

Du Pont Blasting Caps are made in several different strengths, but nothing weaker than the No. 6 (red label) strength should be used, because:

They insure complete detonation.

They increase the execution of the explosive.

They offset to some extent deterioration, due to improper storage.

They prevent the loss of the charge by burning.

Blasting caps are put up in boxes of 100 and from 5 to 50 boxes are packed for shipment in wooden cases. They may be exploded by shock, heat or sparks, so must be kept away from fire. They are weakened by moisture and therefore must be stored in a dry, cool place.

FIG. 87.—DU PONT NO. 6 BLASTING CAPS

FIG. 88

When handling blasting caps *great care* should be exercised as they are much more sensitive than dynamite. Therefore, do ***not under any circumstances carry them together with dynamite,*** or loose in your pocket. Keep them away from children or irresponsible people, and do not attempt to investigate their contents by tapping, picking or scraping. In withdrawing them from the box do not use wire, nails or any other sharp instruments as the friction might cause them to explode. A good way to withdraw a cap from the box is to place the cover over all but one of the caps, then invert the box over your hand, when the uncovered cap will fall into the hand. When inserting fuse before crimping, do not rotate the fuse as the end may scratch the fulminate charge of the cap and explode it.

Fuse

Powder wrapped in jute and cotton yarn and sometimes in tape. Many kinds are made, but either the Crescent or Beaver grades are satisfactory for most work about the farm.

Sometimes, especially in windy weather, it is difficult to light fuse because the powder in the outer end may have become damp or a little of it may have spilled out. When this occurs it is well to cut off an inch or so, in order that the powder will be dry. A half inch of the outer end of the fuse should be split with a sharp knife and spread out so that it can be easily lighted in windy weather by pushing the burning end of the match against the fuse immediately after the match has been struck.

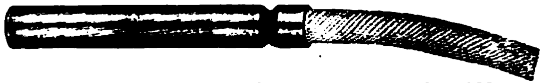


FIG. 89.—BLASTING CAP CRIMPED TO FUSE

Fuse should always be kept dry and should be stored in a cool, dry place. If stored in a damp place it becomes damaged after a time and many fail to burn through. If stored in a hot, poorly ventilated place, as for example, close under the roof of a small shed in summer time, it may be damaged either by becoming soft and oily or by drying out and becoming so hard and brittle that it will break when unrolled. Fuse also may become stiff and brittle in cold weather and when in this condition should be warmed before being unrolled.

Fuse is put up in a double roll, one fitting inside the other each 50 feet long. Each double roll of 100 feet is wrapped separately. It is packed for shipment in wooden cases containing from 500 to 6,000 feet and in barrels containing 8,000 to 12,000 feet.

Dupont Cap Crimpers

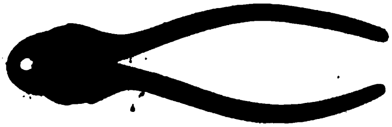


FIG. 90.—DU PONT CAP CRIMPER

Du Pont Cap Crimpers are necessary wherever blasting is done with fuse and blasting caps. Without a cap crimper it is impossible to attach the blasting cap securely or safely to the fuse. The Du Pont Cap Crimper has in addition to the crimping jaws, which make a water-tight crimp, two shears for cutting fuse and a straight arm to make the hole in the cartridge for the insertion of the blasting cap.

Victor Electric Fuzes

Victor Electric Fuzes are made in three strengths—Nos. 6, 7 and 8—with two copper wires 4 feet, 6 feet, 8 feet and so on up to 30 feet in length. For work on the farm the No. 6 strength is sufficient. Victor Electric Fuzes, like blasting caps, can be exploded by shock or heat, and therefore must be handled in exactly the same way. The same precautions regarding storage and handling as given for blasting caps should be strictly observed. Never attempt to pull the wires out of their setting or investigate the contents of Victor Electric Fuzes.

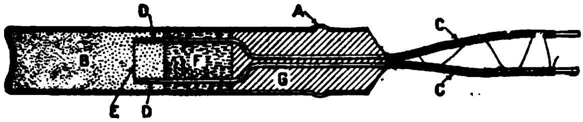


FIG. 91.—ELECTRIC FUZE CROSS SECTION

"A" is the shell of copper, having a corrugation thrown out from the inside, which holds the filling material more firmly in place; "B" is the chamber containing the explosive charge; "C" the insulated copper wires entering the cap; "D" the bare ends of the copper wires projecting through the plug into the charge; "E" the small platinum wire or "bridge" soldered to and connecting the two ends of the copper wires, which is heated by the electric current; "F" the composition plug holding the fuze wires firmly in place; "G" the filling material.

Electric fuzes have two insulated copper wires sealed in the cap. The tips of these wires inside of the cap are bare and joined together by a platinum wire finer than a thread. When the electric current passes through the electric fuze it makes the platinum wire hot enough to detonate the explosive in the copper cap.

Besides the advantageous properties of the No. 6 Blasting Caps, as enumerated, No. 6 Victor Electric Fuzes reduce the chances of misfires, save time, eliminate delayed or premature explosions and in a good many instances, such as in stump blasting, save dynamite.

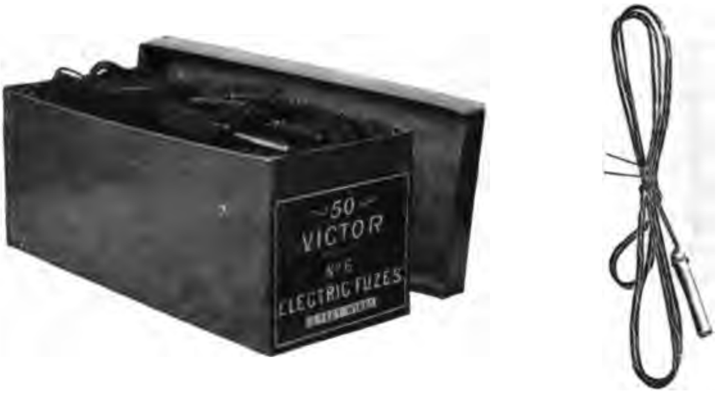


FIG. 92.—VICTOR NO. 6 (RED LABEL) ELECTRIC FUZES

Reliable Blasting Machines

Reliable Blasting Machines are made in three sizes. The No. 2 will detonate from one to ten Electric Fuzes; the No. 3 will detonate from one to thirty Electric Fuzes, and the No. 4 will detonate from one to fifty Electric Fuzes when all of the Electric Fuzes are connected in series. The Blasting Machine is operated by lifting the handle of the rack bar as far as possible and then pushing it down with a constant hard, quick blow. When the rack bar strikes the bottom of the Blasting Machine the current of electricity passes through the wires and detonates the Electric Fuzes. It is well to always place the Blasting Machine upon something firm, level and dry when operating it.

Reliable No. 2 Blasting Machines have two binding posts and the No. 3 size also has two posts unless specially ordered with three. Three-post Blasting Machines will explode at one time 50% more Electric Fuzes than two-post Blasting Machines of the same size. The leading wires are connected to the Blasting Machine by pushing the well-scraped bare ends through the small hole in the binding posts and screwing the wing nut down firmly on them. When a three-post Blasting Machine is used with three leading wires, the ones from the two outside posts are connected to the first and the last Electric Fuzes in the circuit, and the one from the middle post is connected between the two middle Electric Fuzes in the circuit. A three-post Blasting Machine may be used with two wires only by connecting these wires to the middle and either one of the outside binding posts—not the two outside ones. Reliable Blasting Machines, if properly used, will wear for many years. They must be kept out of the wet and mud and must not be thrown about carelessly. If it is necessary to use them in wet weather or on wet work, they should be carefully wiped off before putting them away. A Blasting Machine should not be put in a hot place to dry out if it has become wet, but after being wiped off should be put away in a cool, dry place until it has had time to dry out slowly.

Blasting Machines should be tested occasionally with a Du Pont Rheostat to be sure that they are up to standard capacity. A description of the Rheostat and instructions for using it will be forwarded on application.

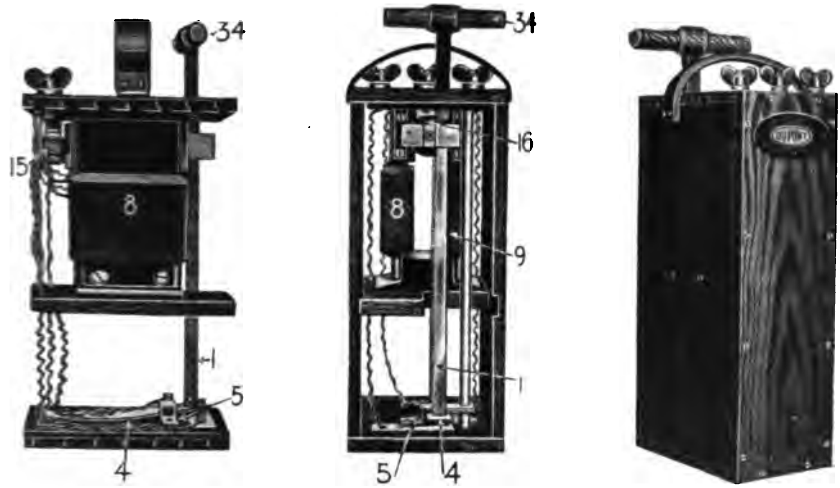


FIG. 93.—INTERIOR AND EXTERIOR VIEWS OF 3-POST BLASTING MACHINE

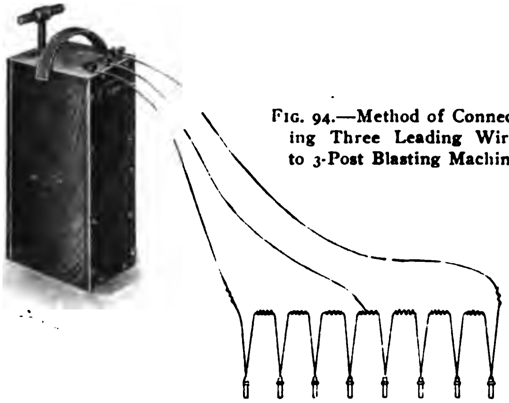


FIG. 94.—Method of Connecting Three Leading Wires to 3-Post Blasting Machine.

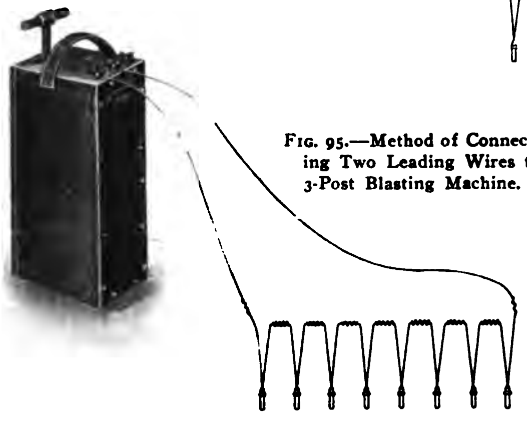


FIG. 95.—Method of Connecting Two Leading Wires to 3-Post Blasting Machine.

Series connection with blasting machine. The break in the wires is merely to indicate that any required length of wire may be used between electric fuzes and blasting machine. There must be no break in the actual circuit.

Leading Wire

Leading Wire is sold in coils of 200 feet, 250 feet, 300 feet and 500 feet. There are two kinds, Single and Duplex. In the Duplex Wire, the two wires are bound together, which usually makes it more convenient to handle. Single Leading Wire weighs about two pounds to the hundred feet, and Duplex Leading Wire weighs four pounds to the hundred feet. Leading Wire is sold by the pound.

Connecting Wire

Connecting Wire is sold in 1-lb. and 2-lb. spools. A 1-lb. spool of No. 20 Connecting Wire holds about 210 feet.

FIG. 96.—COIL OF LEADING WIRE

FIG. 97.—SPOOL OF CONNECTING WIRE

Tools Used in Agricultural Blasting

Tools necessary in farm blasting are to be found on almost every farm or can be easily made there or at the nearest blacksmith shop. The holes for blasting stumps, boulders, trees, ditches, post holes, road grading, trenches, etc., can all be made with a crowbar having a point at one end and a flat chisel edge at the other. The wooden tamping stick can be made in half an hour by dressing down a hard wood sapling, or, if the holes are shallow, an old broomstick will do. A long handle shovel and a grub-hoe or mattock are always serviceable when blasting stumps and boulders. Although a crowbar is very satisfactory for making a moderate number of holes, it will usually be found of advantage, if the work is extensive, to secure augers or bars especially made for the purpose. Sometimes a steel rod one-quarter of an inch in diameter and five feet long with a sharp slender point at one end and a ring on the other is serviceable for probing under a stump to find out the size and position of the main roots.

When draining swamps by shattering the impervious subsoil under them it is sometimes necessary to make the holes for the dynamite much deeper than can be done with a crowbar. For this work rod or pipe extensions for the augers are used. In subsoiling, a bar a little heavier and shorter than a crowbar is also used. This subsoil bar can be removed when it becomes fast by means of a trace chain and a lever.

Below we illustrate a punch-bar which can be made by any blacksmith in a very short time. All the materials required are nine feet of ordinary water piping 1¼ in. inside diam., one 1¼ in. tee, one 1¼ in. coupling, and nine inches of 1½ in. round steel. The pipe should be cut into two lengths 3½ feet each and two lengths 12 inches each. The 9 in. piece of steel should be inserted into one of the 3½ ft. lengths, about 3 inches, and welded, it should then be pointed pin shape. The remaining parts should be put together as per illustrations.

This tool can be very successfully used for putting down subsoil, tree planting, ditching, and, with extensions, deep drainage holes. The method of working with it is to start the hole in exactly the same manner as when a crowbar is used. After the hole is some 6 or 8 inches deep a little water should be poured into it. The drill is then placed in the hole and by working it up and down a three-foot hole can be put down in less than one minute. Holes of any depth and at any angle can be put down without difficulty. When putting down deep holes, extensions have to be added. It is especially adapted for placing holes under stumps or boulders as it will work around the small roots of stumps, and push aside small stones or pebbles around and under boulders. The use of the water facilitates its penetrating power and prevents jamming.

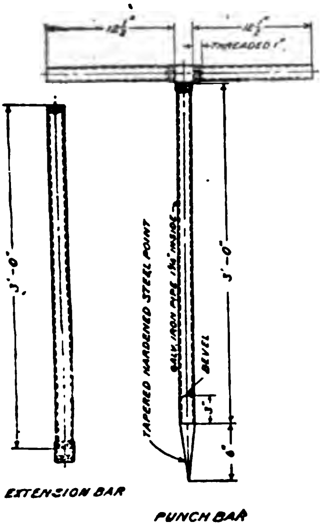


FIG. 98.—PUGH PUNCH BAR AND EXTENSION

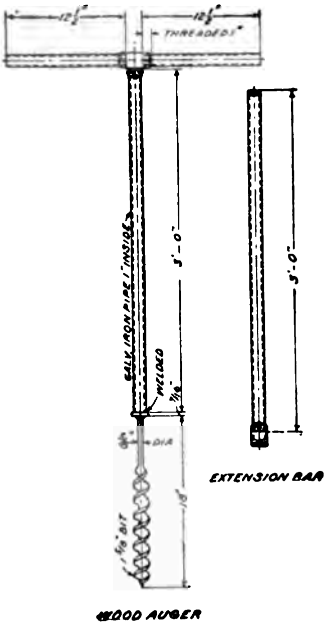


FIG. 99.—PUGH WOOD AUGER AND EXTENSION

These tools may be obtained of any hardware dealer or direct from Job. T. Pugh, 31st and Ludlow Sts., Philadelphia, Pa., at these prices: F. O. B. Philadelphia, Punch Bar, $2.40; Wood Auger, $2.60; 3-ft. Extensions, 50 cents each. Local prices will run higher to cover freight charges. These tools are made on specifications of the Du Pont Company, and will be all that the average blaster will need for making bore holes in earth or wood.

FIG. 100.—STEEL SUBSOIL BAR

Useful for making holes in shale or very tough hardpan. It can be made by any blacksmith from 1½ steel. It is driven in by means of a 16-pound maul. If it sticks, it may be withdrawn by looping a stout chain a few times around it near the ground, and prying it with a rail or crowbar passed through the loop of the chain.

Principles of Blasting

When dynamite explodes, that is, when the small mass of dynamite is changed into a very large volume of hot gases, these gases exert a strong pushing force equally in every direction because they require a much larger space than the dynamite which produced them. If the dynamite is shut up in a space just large enough to hold it, that is, if it is closely confined before it is exploded, the gases in escaping to the open force out and carry along with them the material which shuts them in.

These gases, pressing equally in every direction, will escape principally where there is the least pressure to hold them in, that is, along the lines of least resistance, and will force out the material confining them more in that direction than in any other. If the back pressure holding them in is about the same over the top and on all sides, then they will carry with them, or break up as they escape, a large amount of the material which shuts them in, but if one place in the earth or rock around them is much weaker than all of the rest then the pressure will force through there and the gases will escape without doing as much work as they should.

It must be remembered then that in order to have a charge of dynamite do good work it must be so placed that the holding-in pressure is as nearly as possible the same on top and all sides of it. If a charge of dynamite explodes properly the change into gases is almost instantaneous, although some time is always required and some kinds of dynamite explode—or "detonate" as it is often called—more rapidly than others.

Sometimes a charge of dynamite explodes imperfectly or may even burn partly or entirely. When only part of the charge explodes so little work may be accomplished that it will have to be done over again. The gases given off by burning dynamite are quite different from those of properly exploded dynamite and are often very poisonous. Imperfect detonation is usually caused by the use of weak detonators or dynamite that is insensitive because of being frozen or chilled.

Chilled or frozen dynamite will rarely do good work. The other principal causes of poor results in blasting are insufficient tamping or the improper location of the charge. Poor results may also be due to too large or too small a charge or to the use of the wrong strength or wrong kind of dynamite.

Dynamite is exploded by a detonator. There are two styles of detonators, one known as a blasting cap and the other as an electric fuze (pronounced fu-zee). Both are small copper cylinders about a quarter of an inch in diameter and from one and a half to two and one-eighth inches long, which contain a small quantity of a very powerful explosive. This explosive is quite sensitive to heat and shock and a hard, sharp blow may explode it, so detonators must be carefully handled.

The heat to detonate a blasting cap is provided by the spark from a piece of fuse, one end of which has been pushed into the open end of the blasting cap, and fastened there by crimping the blasting cap on it with a cap crimper. When the other end of the fuse is lighted it burns through slowly and when the fire reaches it the blasting cap explodes.

Nothing weaker than the No. 6 (red label) Blasting Cap or Electric Fuze can be depended on to properly explode dynamite.

When more than one charge of dynamite is to be exploded at the same instant, the blasting must be done electrically. If the charges are too far apart for the wire of one electric fuze to be connected directly to that of the next one, it is necessary to use connecting wire to join them.

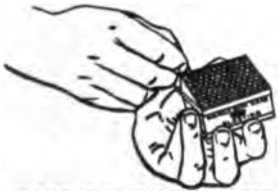
The electric current for detonating electric fuzes is produced by the blasting machine and is carried to the electric fuzes through leading wire.

Method of Exploding Dynamite

The detonator, to do its work properly, must be closely surrounded by the dynamite, because air in the open space between the detonator and the dynamite acts as a cushion when the detonator explodes and lessens the shock to the dynamite. This may result in an imperfect explosion of the dynamite with but little work done. When the charge of dynamite is all pressed together in a mass one detonator is sufficient to explode it. If it is strung out for fifteen or twenty feet in a deep bore hole it is generally best to use two detonators.

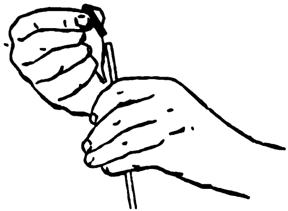
Preparing Caps and Fuse

Placing the detonator in the cartridge of dynamite is called priming it, and the cartridge with the detonator in it is called the primer cartridge or primer. When the charge consists of more than one cartridge the primer should generally be loaded last or next to last.



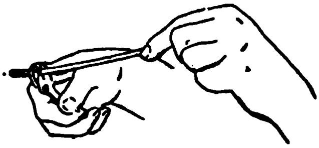
TAKE OUT BLASTING CAP

FIG. 101



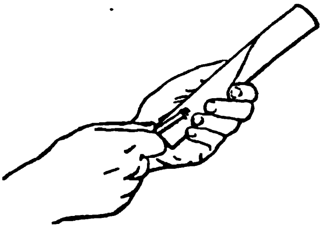
INSERT FUSE IN BLASTING CAP
BUT DON'T TWIST CAP AROUND

FIG. 102



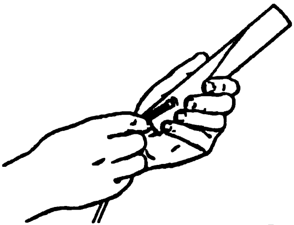
CRIMP THE BLASTING CAP TO FUSE SECURELY WITH DU PONT CAP CRIMPER

FIG. 103



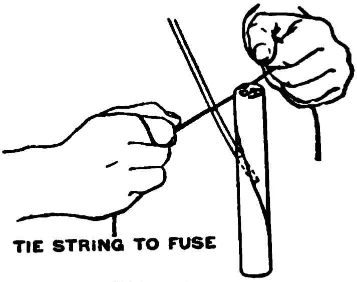
PUNCH HOLE IN SIDE OF CARTRIDGE WITH ROUND POINTED HANDLE OF CAP CRIMPER

FIG. 104



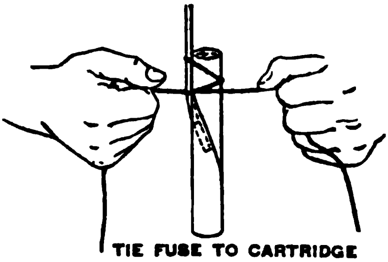
INSERT BLASTING CAP AND FUSE IN CARTRIDGE

FIG. 105



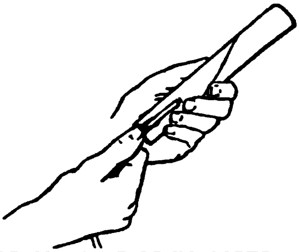
TIE STRING TO FUSE

FIG. 106



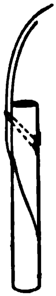
TIE FUSE TO CARTRIDGE

FIG. 107



OR FASTEN FUSE TO CARTRIDGE BY PUNCHING A HAIRPIN THROUGH CARTRIDGE ON BOTH SIDES OF FUSE

FIG. 108



BEND HAIRPIN POINTS UP

FIG. 109

HOW TO PRIME
A DYNAMITE
CARTRIDGE

FOLLOW THESE
DIRECTIONS
CAREFULLY

The FIRST STEP in the preparation of the primer, when using fuse and blasting cap, is to examine your dynamite and see that it is not frozen. Frozen dynamite is hard and rigid; when thawed it is soft. Next examine your fuse, see that it is not stiff and brittle; in this condition it is advisable to warm same slightly before a fire until it becomes pliable. Take your cap crimpers and cut the required length from the roll; cut should be made squarely across and not diagonally. Sometimes in the cutting the end becomes flattened, thereby making the end of the fuse too large to enter the blasting cap. It is therefore advisable to squeeze the end round with index finger and thumb. Insert this end carefully into the detonator, well down to the explosive charge. *Do not twist it about.* The charge is very sensitive and the friction caused may explode it. Although this operation is not dangerous, yet great care should be exercised. After the fuse is inserted into the detonator as above described, take the cap crimper and crimp detonator to the fuse. The crimp should be made near the end which the fuse enters, so as not to disturb in any way the explosive charge which the blasting cap contains. *Do not use common pincers, knife, or the teeth* in this operation. If the work is wet, then smear the joint with tallow, wax or soap. *Do not use oily grease* as the oil might penetrate the fuse wrapping and spoil the powder.

The next operation is the insertion of the cap into the dynamite cartridge. There are two methods of doing this, namely: (1) By punching a hole diagonally into the side of cartridge, insert blasting cap into same and tie fuse with a piece of twine to side of cartridge. Electric fuzes may be inserted and fastened in the same manner. Another quick method of fastening fuse—but not electric fuze wires—is to straddle the fuse with an ordinary soft iron wire hairpin, pushing the legs of same right through the cartridge and bending them upward on the opposite side. Do not use steel wire hairpins and do not use this method to fasten electric fuze wires as it may short-circuit them and cause a misfire. If only a half cartridge is required for a charge, each end of the whole cartridge should be primed as described above before cutting it in half, as by doing this loss of dynamite from spilling is obviated—*do not* cut, break, or puncn a hole into frozen dynamite cartridges; or (2) by unfolding paper wrapper at one end of cartridge and punching a hole about 1½ inches deep with the rounded handle of the cap crimper. Into this insert the cap with fuse, draw paper wrapper over and tie same tight with a piece of twine.

Method No. 1 is preferred by most agricultural blasters because it leaves the whole top of the cartridge intact for tamping, and also leaves a cushion of dynamite between the tamping stick and the detonator, making the operation of tamping easier and safer.

Charging

Having primed the cartridge in the manner described, insert it in the borehole on top or next to top of the rest of the charge if more than one cartridge is used and push it carefully home. Putting the explosive into the borehole is called charging or loading the borehole. It is generally best in *dry ground* to slit the paper shells lengthwise in two or three places with a sharp knife before putting the cartridge into the borehole, as a slit cartridge will spread out in the borehole better. The primer should not be slit. Push the cartridges, except the primer cartridge, firmly into place with a *wooden stick* so that they will expand and fill up their part of the hole, for crevices or air spaces may lessen the power of an explosive. Expanded cartridges also occupy less of the length of the borehole and make possible a heavy charge at bottom of hole. The primer is loaded last, or next to last, and is pushed down only hard enough to touch the preceding cartridge. Each cartridge must touch the one previously loaded, for if any space between the cartridge occurs through falling dirt or stones, or through the sticking of a cartridge in the borehole, a part of the charge may fail to explode.

Never force a primer into a borehole, because the detonator which it contains is sensitive to shock and might explode if too much force is used.

Tamping

After the charge is pressed home, as directed, put in two or three inches of fine dirt or damp sand, and with a *wooden stick* press it gently on top of the dynamite. Then fill up two or three inches more of the hole, packing it in a little more firmly. After five or six inches covers the charge, it may be pressed firmly into place without danger of premature explosion. The tamping material should be packed as firmly on top of the charge as can be done without moving the electric fuze or blasting cap in the primer, but it is not safe to tamp by a blow any stronger than can be given by hand. Fill the borehole up with tamping until even with the surface. The firmer and harder the tamping can be made (without overlooking the above precautions) the better will be the results. If the borehole is not properly tamped, the charge is likely to "blow out," or at any rate some of its force will be wasted.

Do not use iron or steel bars or tools for tamping because the metal tools may detonate the explosives. Use only a wooden tamping stick with no metal parts.

FIG. 110.—HOME MADE TAMPING STICK

Firing

Exploding the charge is called firing and can be done either by caps and fuse or electrically by electric fuzes and blasting machine. When cap and fuse are used cut the fuse long enough to enable you to retire to a safe distance. Fuse burns on an average of two feet per minute and on page 140 is a table showing the line of safety to be observed for various classes of blasting, as also the amount of fuse required to enable the blaster to reach same.

Never light the fuse or operate the blasting machine until you have warned everyone near that you are about to fire, and until you are thoroughly satisfied that there is no one sufficiently near to be injured by the material thrown into the air by the blast.

Never investigate a misfire immediately. It sometimes happens that the charge does not explode exactly when it should but does so a little later. This rarely if ever occurs when firing electrically, but is not so infrequent when fuse is used, because careless tamping sometimes tears or abrades the fuse so that it will burn very slowly. A misfire with fuse should *not* be investigated for at least one-half hour, but it is much better to wait a full hour. When firing electrically be sure that all your connections are OK and do not connect the leading wire to the blasting machine until everything else is ready for the blast. This will prevent some inexperienced person from accidentally operating the blasting machine and exploding the charge before the blaster has had time to reach the safety line.

What To Do in Case of Misfire

Never try to dig out the old charge. Make, charge and prime a new borehole far enough from the first to make sure the tools will not touch the first charge.

Always fire just as soon as possible after tamping. In fact priming, charging, tamping and firing should be done as quickly as it is possible to do them thoroughly, because wet or even damp ground may injure the dynamite or even the detonator to some extent and in cold weather dynamite may become chilled or frozen which makes it insensitive. When viewing a blast it is always advisable to look out carefully for falling material which may be thrown farther than anticipated and a position should always be taken so that the sun and wind will be at youı back. In any case the sun should *not* be faced, as in doing so it is naturally difficult to discern material flying through the air. Look up in the air, rather than at the stump or boulder being blasted.

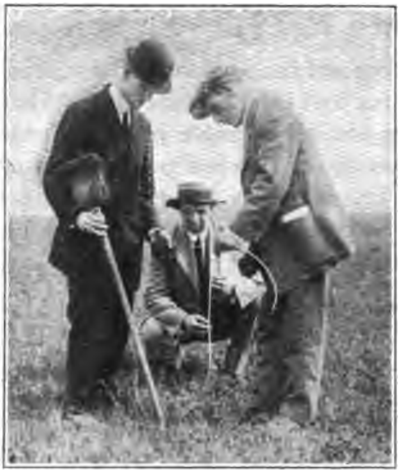


FIG. 111
Lowering Primed Cartridge Into Hole

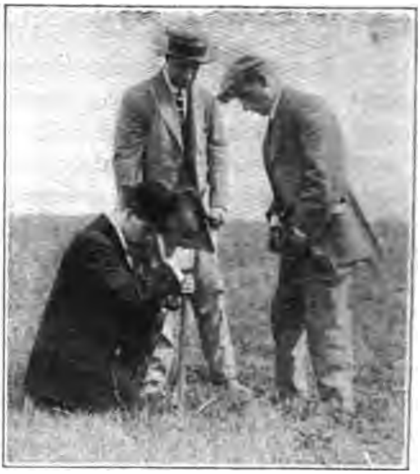
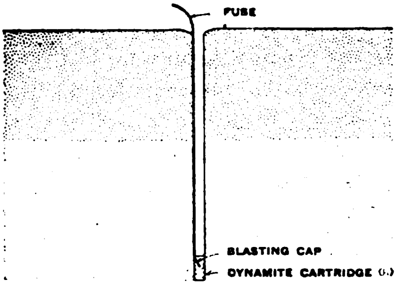
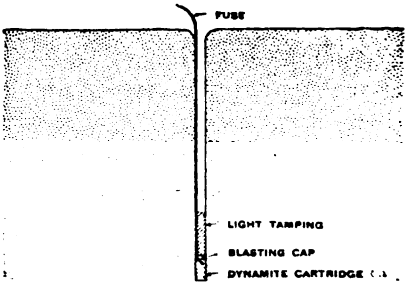


FIG. 112
Tamping With Broom-Stick



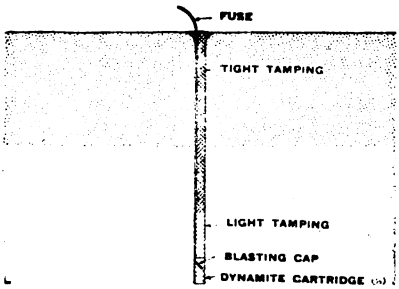
PRESS CARTRIDGE DOWN GENTLY: DON'T POUND

FIG. 113



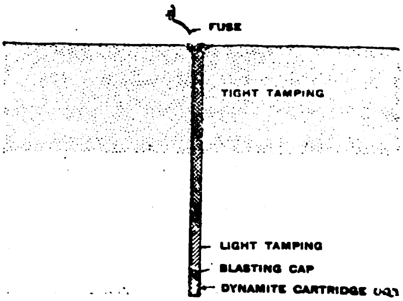
PUT IN 6 TO 10 INCHES OF EARTH AND TAMP LIGHTLY

FIG. 114



TAMP FIRMLY TO THE TOP AND IT IS READY TO FIRE

FIG. 115



LIGHT FUSE AND RETIRE TO A SAFE DISTANCE

FIG. 116

FIG. 117.—BLASTING STUMPS ELECTRICALLY

Blasting by Electricity

Large boulders and large stumps with spreading roots can often be blown out and broken up more thoroughly and with less dynamite if it is distributed in several charges in different places under the boulder or stump and all of these charges exploded at one time. Groups of stumps standing close together can also be blasted in this way. In order to dig a ditch satisfactorily it is always necessary to explode a number of charges simultaneously. In well sinking and other kinds of blasting it is of advantage to explode a number of charges at one time, as each tends to help the other. The only way in which several charges some distance apart can be exploded at exactly the same time is by the electric method of blasting. Electric blasting may, of course, if so desired, be applied to all of the work described in this Handbook, but it is generally unnecessary and more expensive, except in the blasting just described.

The equipment for blasting by electricity, in addition to dynamite, consists of

Electric Fuzes	Leading Wire
Connecting Wire	Blasting Machine

When the charges of dynamite have been primed with electric fuzes and tamped as already described, the two electric fuze wires extend from the ground over each charge. These two wires should be separated and one of them connected to one of the wires of the next electric fuze on one side and the other one should be connected in the same way to one of the wires of the electric fuze in the hole on the other side. This should be continued until all of the charges are connected in a row with one free wire extending from the first charge and another extending from the last charge. This is called "connecting in series." If the holes are too far apart for the electric fuze wires to reach between them, pieces of connecting wire will have to be used to connect the electric fuze wires in adjoining charges.

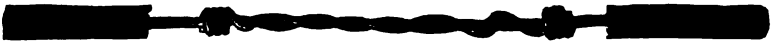


FIG. 118.—PROPER WAY TO MAKE CONNECTIONS

Connections are all made by twisting bare wire ends securely together. All wire ends should be scraped with an old knife so that they will be free from grease or corrosion when connections are made.

All bare joints or other uncovered places in the wire must be kept away from water or damp ground. This can be accomplished by putting a stick, block of wood or stone under the wire on each side of the bare place.

The Du Pont Company manufactures an instrument for testing blasting circuits, called the Du Pont Galvanometer. This is a very ingenious and useful instrument where much blasting is done by electricity, and saves much time in locating breaks in electric circuits. For instructions as to its use ask for Galvanometer Booklet.

Instructions for Agricultural Blasting

In the following pages it is our endeavor to give as nearly as possible definite instructions as to the various methods employed to do different kinds of blasting about the farm. Due to the diversity of local conditions, such as nature of soil, thickness and quality of the subsoil or hardpan, the root system of trees, position and grain of boulders, etc., it can be readily understood that it is practically an impossibility to be able to outline any precise method of procedure, that will fit every case, and accordingly it may be found of advantage to vary from the instructions relative to the charge of explosives to be used. Nevertheless if they are fully followed in a general way, but little experience will enable the operator to do the work even more quickly and economically than when first he attempts it.

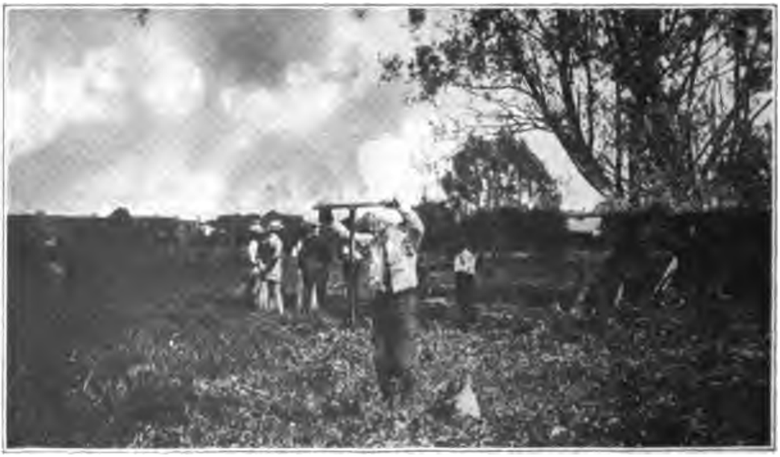


FIG. 118A.—MAKING HOLES WITH PUNCH BAR

Blasting Stumps.

"Root systems of the different forest trees are subject to a considerable number of variations, due to the class of tree, the soil and the depth to sheet water. Ordinarily, forest trees are divided according to their root systems into three classes. These are: Those having tap roots; those having no tap roots but only lateral fibrous roots; and those having both a small tap root and many fibrous roots. When trees that normally develop heavy tap roots are grown on soils where the ground water level is very near the surface, the tap root will be materially shortened or entirely wanting. Fibrous rooted trees growing in loose soils not troubled by bad drainage, may send heavy lateral roots to considerable depths. The highly resinous tap roots of such trees as the pine decay very slowly."

Several factors very materialy influence the blasting of stumps, notable of which are:

The character of the root, whether tap or fibrous.

The nature of the soil with regard to the resistance it offers the explosive.

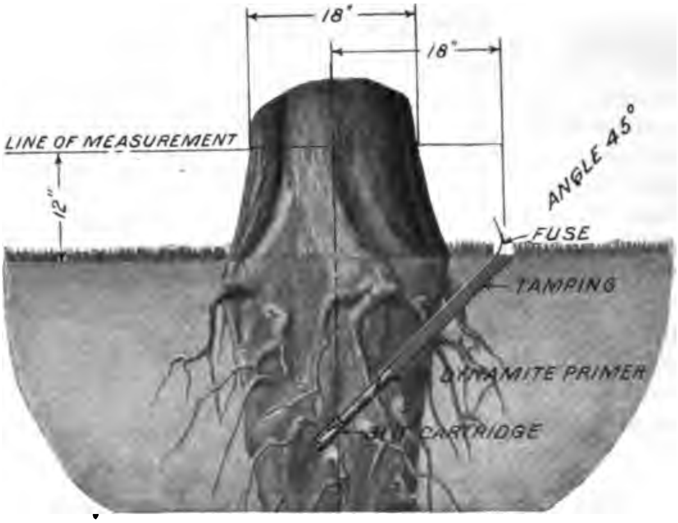
The state of preservation of the stump, whether sound or partially decayed.

Freshly cut or green stumps are much harder to blast than those from which the small fibrous roots and bark have decayed.

Tap rooted stumps are easier to blast than fibrous rooted ones. The semi-tap rooted ones are slightly more difficult to blast than the tap rooted ones, but not so difficult as the fibrous rooted ones.

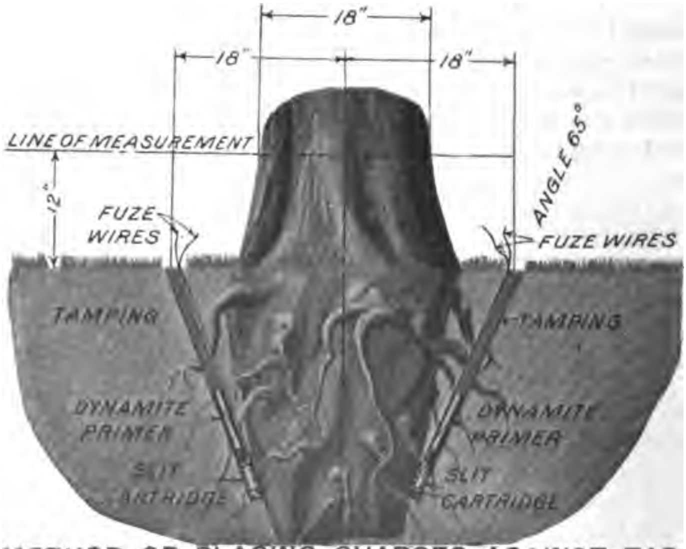
In doing successful and economical stump blasting all depends on the proper location of the charge. For stumps of the tap-root variety the best method is to bore into the tap root as shown in Fig. 119. The usual method of doing this is to start a hole with a 1½-inch punch bar or dirt auger at a distance away from the center of the stump equal to its diameter, inclined at an angle of about 45 degrees towards the center until the tap root is encountered. The earth tool should then be exchanged for a wood auger and the hole continued to ¾ of the way through tap root. Care should be exercised not to bore entirely through this as in that case a good deal of the force of the dynamite when it explodes will be wasted in the soft ground beyond the tap root. The charge to be employed should vary from 1 to 6 cartridges of Red Cross Extra 40% Dynamite, the size of the charge varying in proportion to the size of the stump. Charge should be primed with cap and fuse and firmly packed—the tighter the better. Priming, charging and tamping instructions are found on pages 119 to 124.

If you have a blasting machine and Victor Electric Fuzes and you wish to avoid the necessity of boring into tap root, we recommend placing the charges of dynamite firmly against the tap root as in Fig. 120. Charges should be primed with No. 6 Victor Electric Fuzes and firmly tamped. The electrical blasting methods are fully explained on pages 125 and 126.



SHOWING CORRECT LOCATION OF CHARGE PLACED INTO TAP ROOT

FIG. 119



METHOD OF PLACING CHARGES AGAINST TAP ROOT FOR ELECTRICAL BLAST

FIG. 129

When blasting out stumps of the semi-tap or lateral root variety, that is stumps having both tap and lateral roots, the paramount idea is to remove not only the part of it that projects above the ground, but to cut off and displace the roots below plow level. It is therefore necessary to place the charge well down in a central position below the stump in order that the explosion may exercise an equal pressure on all the roots.

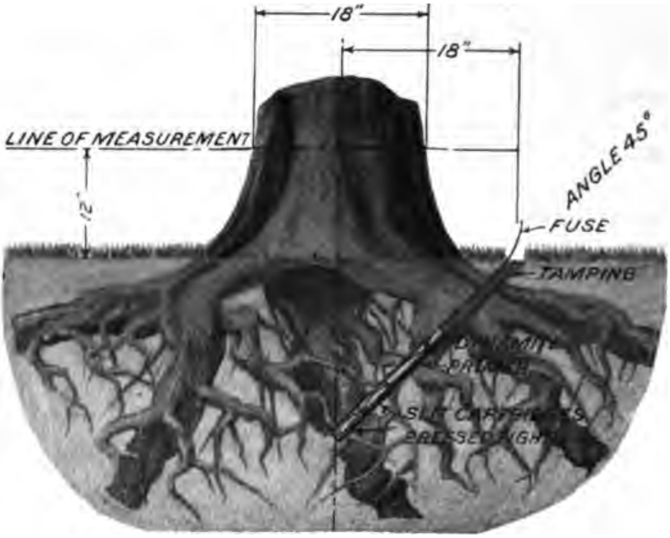
A good many beginners in trying to carry out this principle make the common mistake of calculating to get the bottom of the borehole under the center of the stump as we endeavor to show in Fig. 121. As may be observed that point would be the ideal location for the charge, but it must be taken into consideration that if a charge of 3 cartridges is used in a 1½-inch borehole, this will occupy at least 20 inches of the length of same, thereby leaving very little space for thorough tamping.

Furthermore, the bulk of the charge would not be under the center of the stump and would have the tendency to blow out the loaded side only and in doing so it would probably remove only half of the stump, leaving the other half remaining in the ground, with practically no soil resistance to enable the blaster to put a fresh charge on the opposite side.

It is therefore apparent that an effort should be made to locate the centre of the charge at a point beyond the centre line of the stump, as shown in Fig. 122. To accomplish this correctly, a 1½-inch diameter hole should be bored at an angle of about 45 degrees inclined towards the center of the stump. This hole should be started at a distance away from the center of the stump equal to its diameter, and should be of sufficient length so that the bottom of same will be past the center line of the stump. Primer should be made with cap and fuse. The instruction for making the primer as also regarding loading and tamping should be carefully carried out as contained on pages 119 to 124.

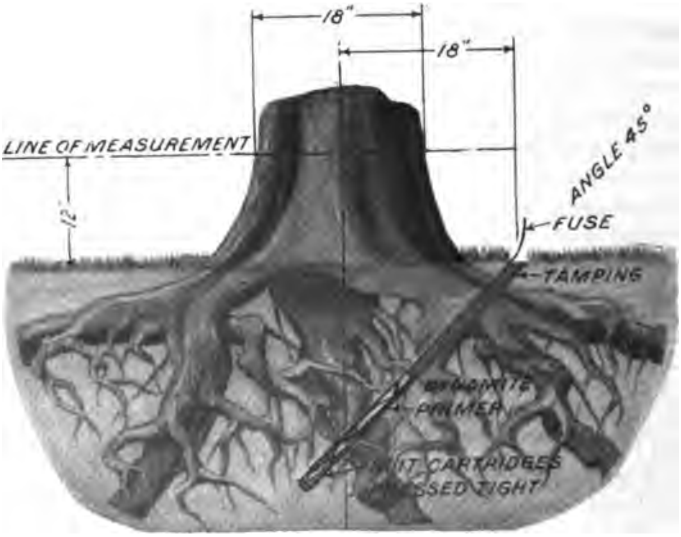
Stumps having a large diameter can also be blasted out by the cap and fuse method with a single charge by boring a hole past the center line and enlarging end of same with one-quarter of a cartridge of dynamite primed with cap and fuse. This small charge should be pressed down to the bottom of borehole and should not be tamped. The result will be as shown in Fig. 123. *Under no consideration should the hole be charged until it has had time to cool off.* The best plan is to work on other stumps awhile to give the chamber ample time to cool.

We recommend, however, that large stumps be blasted electrically. This is done by boring auger holes either partly through or under the principal spreading roots and one deep hole placed under the center of stump (Fig. 124). All charges should be primed with No. 6 Victor Electric Fuzes, wires of which should be connected together to form a circuit. The first and last wires remaining should be attached to the two leading wires which are connected to blasting machine. Although large stumps can be successfully blasted by the ordinary cap and fuse method, we recommend the electrical system, as there is an economy in dynamite and results more satisfactory.



SHOWING INCORRECT LOCATION OF CHARGE BORE HOLE NOT LONG ENOUGH

FIG. 121



SHOWING CORRECT LOCATION AND DEPTH OF CHARGE

FIG. 122

For cypress, willows or stumps in very soft soil the following method of blasting is recommended. Place three to six holes (according to size of stump) twelve to eighteen inches away from stump between lateral roots at an angle of about 75 degrees inclined towards center of same (Fig. 126A). Each hole should be charged with one or more cartridges of Red Cross Extra 40% primed with electric fuze and fired with blasting machine. By adopting this method, the stump will be split into six or seven pieces and all roots extracted, leaving a very slight indentation in ground.

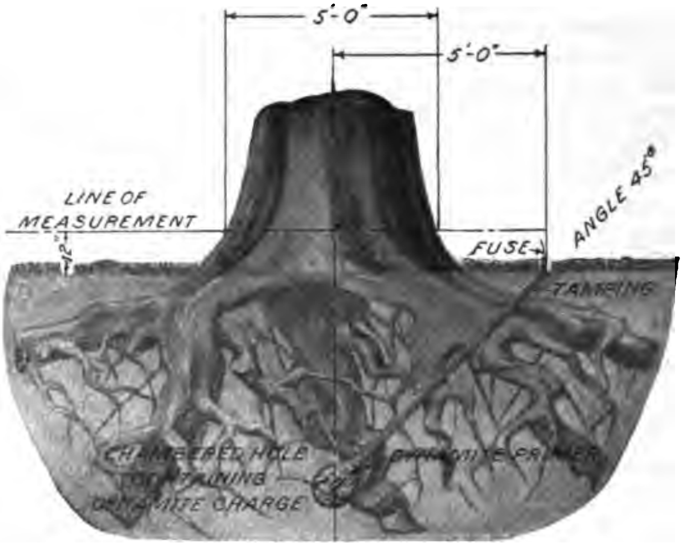
Table of Stump Charges

The following table will enable the beginner to obtain an idea of the number of Red Cross Extra 40% Dynamite cartridges required for various size stumps. These figures are for old but sound stumps. Fresh, green stumps will require one-half more or twice as much dynamite, and partly decayed stumps less than amounts shown. After he has obtained a little efficiency in doing his work he will see that he can in the majority of cases considerably reduce these charges.

Diameter of Stumps in Inches	12	18	24	30	36	42	48	54	60	66	72
Approximate No. of 1¼″ x 8″ Cartridges Red Cross 40% Extra Dynamite.	1½	2	3	4	6	8	10	12	14	18	22

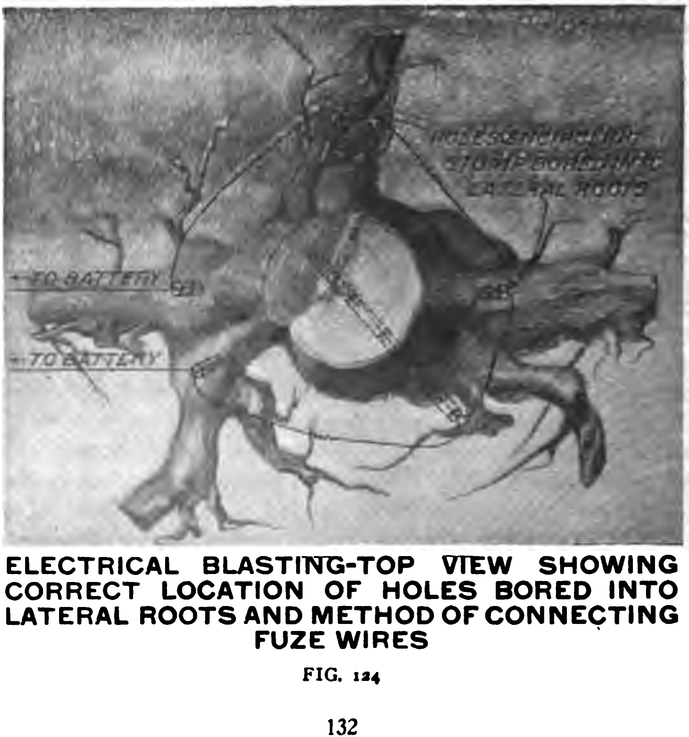
20% Red Cross Dynamite for Stumping

In many soils, except loose sand or swamps, it is possible to blast out stumps more economically with 20% Red Cross Dynamite than with the 40% strength. On the other hand in very loose or swampy soil it is sometimes advantageous to use Du Pont N. G. Dynamite, 60% strength. The theory is this: Sand or muck will blow out much easier than the stump and offers little resistance. Hence, unless there is a good amount of sand or muck *between* the charge and the stump, the stump may not be blown out. But 60% N. G. Dynamite is so fast and powerful it blows the stump out before its power is lost through the sand or muck. On the other hand where the soil is loam or clay it offers good resistance and confines the force of 40% or 20% Red Cross Dynamite long enough to ensure getting out the stump.



SHOWING "CHAMBERED" OR "SPRUNG" BORE HOLE FOR BLASTING LARGE STUMPS WITH ONLY ONE CHARGE

FIG. 123



ELECTRICAL BLASTING-TOP VIEW SHOWING CORRECT LOCATION OF HOLES BORED INTO LATERAL ROOTS AND METHOD OF CONNECTING FUZE WIRES

FIG. 124

Western Fir, Pine and Cedar Stumps

In the States of Washington, Oregon and parts of California, where the rainfall is large and the ground in the forests is always damp, many of the trees grow to great size—some being eight or ten feet in diameter. The roots of these trees usually spread out near the surface and do not grow deep into the ground as might be expected, tap roots being extremely rare.

The object when blasting these stumps is not to split them but to bring them out entire at one blast, with all of the roots possible, because if the charge of explosives is so gauged and located as to split the stump, it generally fails to bring out all of the pieces. As the principal object is to get out as much of the stump as possible at a minimum cost, it is better to blast it out first and then it can be easily split afterwards by means of a small quantity of dynamite exploded in auger holes.

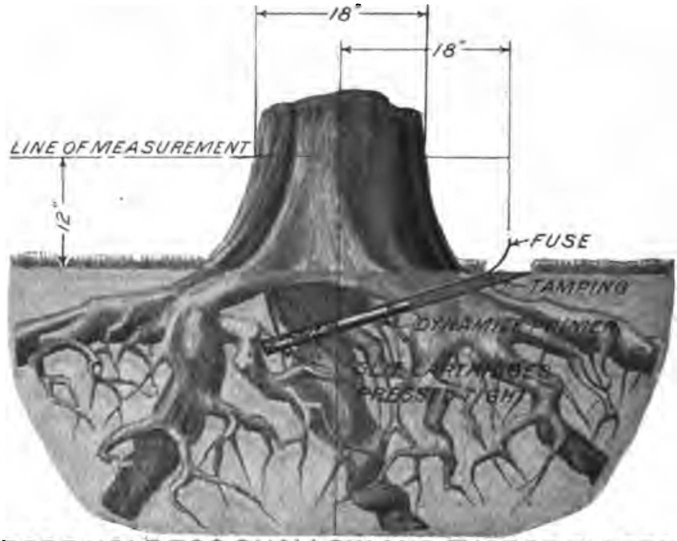
The common rule in blasting these stumps is to use one and one-half pounds of Hercules Powder-Stumping L. F. per foot of diameter, with stumps up to four feet, when the subsoil is clay. For larger sizes from two to two and one-half pounds for each foot in diameter should be used. Stumps in gravelly or loose ground require one pound more for each foot in diameter.

The charge of explosives is best placed when there is sixteen to twenty-four inches of earth between it and the bottom of the stump. This results in the force of the explosion radiating to all sides, lifting the stump clear of the ground, and bringing with it the greatest length of roots. If the charge is placed too close to the stump, the effect is to split it, leaving the roots to be dug out at extra labor and expense.

When these stumps are large the bottom of the borehole is "sprung" or chambered until it is so large that the increased charge required can be concentrated under the center of the stump. The chambering is done by exploding without tamping, first a half cartridge, then several successive charges of from one to five cartridges each in the bottom of the borehole. When the hole is large enough it is given time to cool off and is then charged with the necessary quantity of Hercules Powder-Stumping L. F. to bring out the stump. *Under no consideration should the hole be charged until it has had time to cool off.*

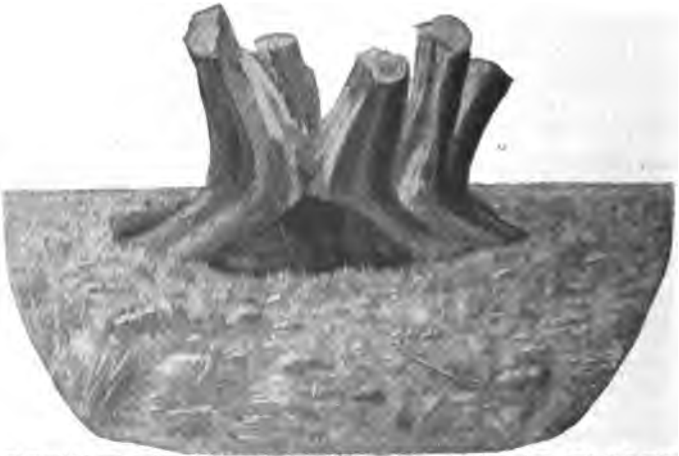
The best plan is to work on other stumps awhile to give the chamber time to cool.

See pages 119 to 126 for proper methods of priming, charging, tamping and firing.



BORE HOLE TOO SHALLOW AND CHARGE PLACED TOO CLOSE TO BOTTOM OF STUMP

FIG. 125



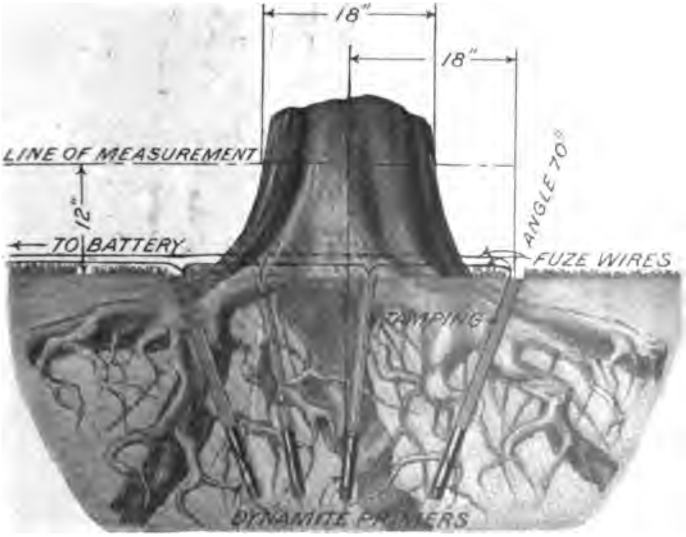
RESULT ATTAINED WHEN CHARGE IS PLACED TOO CLOSE TO BOTTOM OF STUMP AS SHOWN ABOVE

FIG. 126

Redwood and Bigtree Stumps

The way to estimate the quantity of Hercules Powder-Stumping L. F. necessary to blast out stumps larger than eight feet in diameter, is to square the largest diameter in feet, the result being approximately the number of pounds required. For example, if a stump is eight feet in diameter the charge of Hercules Powder-Stumping L. F. should be about the square of eight, or sixty-four pounds. Stumps less than eight feet in diameter require a little greater charge for their size than do the larger stumps, and the rule with them is to use as many pounds of Hercules Powder-Stumping L. F. as eight times the largest diameter in feet. On this basis a stump six feet in diameter would need about forty-eight pounds of powder. However, the successful blasting of these large stumps depends greatly on the judgment of the blaster, and these rules can only be considered as a general guide. This can easily be understood when it is remembered that, owing to difference in soil or some peculiarity in the growth of the tree, it sometimes requires the same quantity of explosives to properly bring out a stump six feet in diameter as it does another one eight feet in diameter.

In blasting these stumps a trench is dug large enough to permit placing the entire charge of explosives directly underneath the center of the stump. A little powder blasted in holes punched with a crowbar will prove of great assistance in digging this trench. (See Fig. 127.)



METHOD OF PLACING HOLES FOR BLASTING CYPRESS, WILLOWS OR STUMPS IN VERY SOFT OR LOOSE SOIL

FIG. 126A

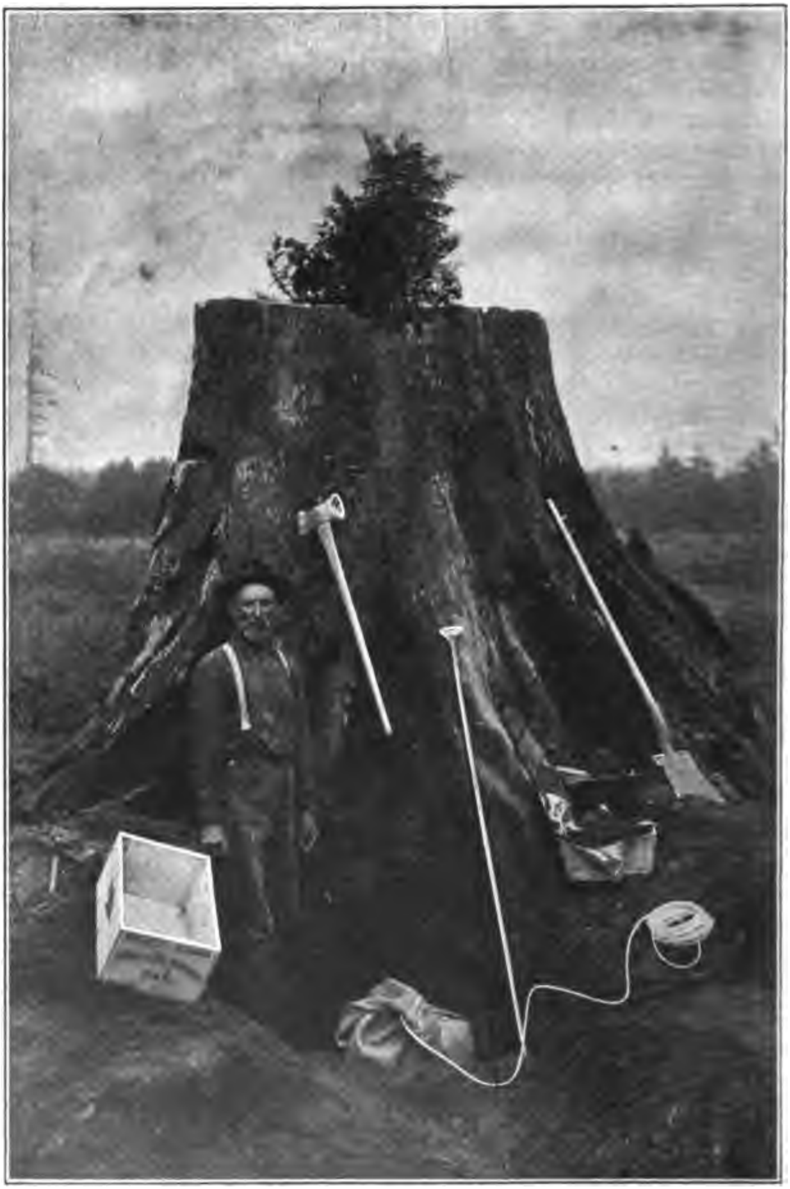


FIG. 127.—ILLUSTRATING METHOD OF PLACING CHARGE UNDER A CALIFORNIA BIG-TREE

The charge should be firmly tamped. Avoid being on the same side of the stump as the trench when the blast is fired, as fragments, etc., are thrown with more violence and to greater distances on that side.

Second-growth Stumps

There is often directly under a second-growth stump the decayed remains of the original stump; this is soft, and the force of the explosive when placed on it seems to merely scatter this dead wood and has no marked effect upon the stump above. To overcome this difficulty, it is a good plan to dig under the stump and place a good sized flat stone between the roots, leaving only room on top of stone for the dynamite. Damp clay should then be firmly packed around the dynamite. This gives sufficient resistance to the explosive to enable it to lift out the stump. Red Cross Extra 40% dynamite should be used. See pages 119 to 126 for proper method of priming, charging, tamping and firing.

Felling Trees

Occasionally when clearing land of growing timber, it is of advantage to blast out the entire tree and saw off the root afterwards.

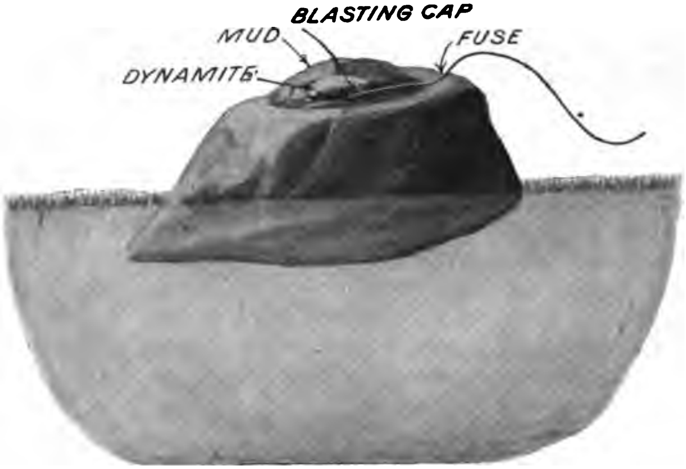
This process here is exactly the same as in stump blasting, but a little more dynamite is required to bring out the tree, roots and all, than to blast the stump after the tree has been cut and the lower part of the trunk is usually split some. The blast lifts the tree straight up a foot or two; then it falls, generally with the wind. See pages 119 to 126 for proper method of priming, charging, tamping and firing.

Splitting Stumps and Logs

When stumps, particularly large ones, are blasted out whole or nearly so, it is sometimes necessary to split them up so that they can be conveniently handled or burned. This can be readily accomplished with dynamite; only a small quantity of explosives being required if the charge is properly tamped in auger holes bored part way through the stump.

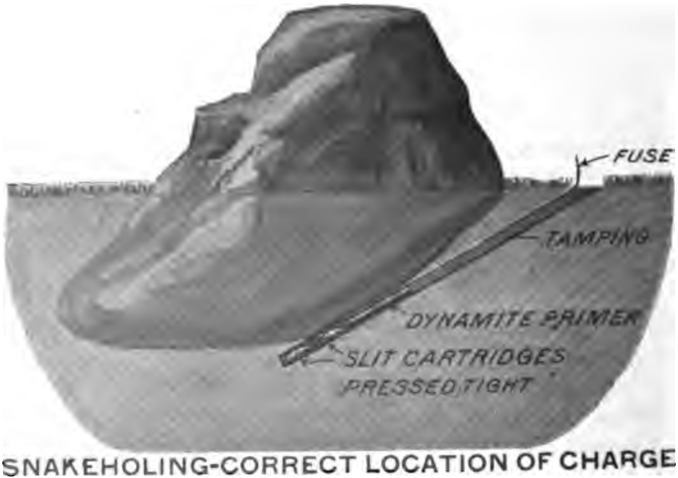
In the South the pine stumps are very large producers of turpentine and by-products. Nothing is so effective as dynamite for breaking up a stump for this purpose. Charges of a few inches of Red Cross 40% Extra Dynamite, exploded simultaneously in several auger holes bored in the stump, will shatter it up into exactly the size required.

When logs are split up to be burned quickly, the same method is used as when splitting stumps; but if they are to be split for fence rails, cordwood, charcoal, or other purposes where comparatively even and regular sections are required, Du Pont Blasting Powder, in granulation FF, FFF or FFFF, should be used.



MUDCAPPING

FIG. 128



SNAKEHOLING-CORRECT LOCATION OF CHARGE UNDER BOULDER

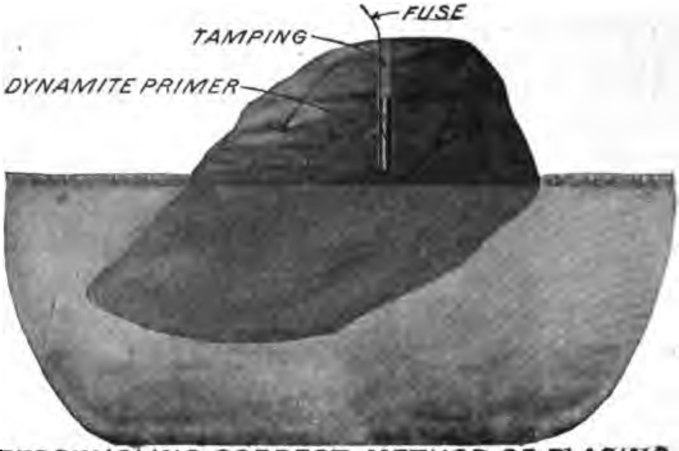
FIG. 129

This explosive is so much slower in action than dynamite that a series of properly gauged and properly placed charges will split a log along the grain, just as evenly as if a number of wedges were used.

This method of splitting logs is so much quicker, cheaper and easier than any other, that those who have once become proficient at it never give it up. Auger holes one inch or more in diameter are bored along the line of the grain, about one-quarter to one-half of the way through the log, the depth of the holes and the distance between them depending on the kind of wood, the grain and the diameter of the log. A few ounces of FF Blasting Powder are put into the bottom of each hole, care being first taken to see that the hole is dry, then wooden plugs are driven firmly into the tops of the holes to tamp or confine the charge.

In some kinds of wood it is best to leave a considerable air space between the bottom of the plug and the powder. The plug must have a groove in the side large enough to admit the electric squib wire or the fuse. As blasting powder is exploded by a spark or flame it is not necessary to use a detonator with it. Electric squibs are similar in appearance to electric fuzes, except that they have a paper capsule instead of a copper cap. They do not explode when the electric current passes through them, but ignite the blasting powder by a flash. If electric squibs and a blasting machine are used for exploding the charges, they can all be fired simultaneously. This usually is the best and cheapest way as a little less powder is required than when the charges are exploded separately with fuse. When using electric squibs, it is only necessary to have the groove or channel in the sides of the wooden plugs large enough for the two small wires to run through it, if the cap of the electric squib is put in place before the plug is driven in. When driving the plug care must be taken that the wires are kept free, and that the insulation on them is not damaged. If it is not convenient to provide wooden plugs in this work, damp clay tamping may be used on top of a wad of newspaper. A log two feet in diameter and four or five feet long, can usually be split in two with one two-ounce charge of FF Blasting Powder. Longer logs require two or more holes and logs of greater diameter require heavier charges. The holes should be from one to two inches in diameter.

Logs may all be split into fairly regular sections with dynamite if care is taken not to use too much. To split a solid oak log ten feet long and four feet in diameter, two or two and a half 1¼ x 8-inch cartridges of Red Cross Extra 20% Dynamite are exploded in a hole drilled from the outside to the center of the log, midway between the ends. This will sometimes split the log in quarters if the charge is properly confined with tamping. Only about half as much dynamite is required to split a poplar log of this size. A two-foot pine log twenty feet long can usually be split in halves with a single 1¼ x 8-inch cartridge or less of Red Cross Extra 20% Dynamite exploded as described above.



BLOCKHOLING-CORRECT METHOD OF PLACING
CHARGE-HOLE BORED INTO BOULDER

FIG. 130

Table of Fuse Lengths

This table is based on an average burning speed of Crescent Fuse of 3 feet per minute. However, fuse that has been loosely rolled—thus admitting more *air* to the powder train inside the fuse, will burn more rapidly. Also, fuse in tightly tamped holes, being under pressure, burns more rapidly. In extreme cases the speed reaches 5 feet per minute. In subsoiling, as there is very little material thrown up, the fuse may safely be cut just long enough to reach from the charge of dynamite to a few inches above the surface of the ground. But in stump blasting, ditching and especially in boulder blasting it is necessary to use a fuse long enough to allow the blaster plenty of time to run far enough away to be out of reach of flying stones or sections of stumps. When a safe distance has been reached keep the eyes on the stump or boulder until the blast occurs, then look upward for falling pieces.

Stump Blasting			Mudcapping Boulder			Snakeholing Boulder			Blockholing Boulder			Ditching			Subsoiling Tree Planting		
Distance to go	Time Required	Least Fuse Length	Distance to go	Time Required	Least Fuse Length	Distance to go	Time Required	Least Fuse Length	Distance to go	Time Required	Least Fuse Length	Distance to go	Time Required	Least Fuse Length	Distance to go	Time Required	Least Fuse Length
200 ft.	1 min.	3 ft.	200 ft.	1 min.	3 ft.										25 ft.	*	*
300 ft.	1½ min.	4½ ft.													*The length of fuse in subsoiling and tree planting is determined solely by the depth of the hole.		
400 ft.	2 min.	6 ft.				400 ft.	2 min.	6 ft.	400 ft.	2 min.	6 ft.	400 ft.	2 min.	6 ft.			

Boulder Blasting

There are three ways in which boulders can be blasted. These are known as "Mudcapping," "Snakeholing," and "Blockholing." "Mudcapping" and "Snakeholing" are the easier and quicker methods, but require more dynamite. It is almost impossible to shatter large round boulders of hard rock by either of these methods, without using an excessive quantity of explosives.

Mudcapping

When blasting boulders by mudcapping them (also called "doby shooting" or "blistering") the charge of dynamite is packed closely against the surface on the top or side of the boulder, covered with mud and exploded. The charge should be placed on the spot which would be struck with a sledge if the boulder were small enough to be broken in that way, and should be packed in a solid mass by removing the paper cartridge shells, but not spreading the contents over the surface of the boulder any more than absolutely necessary. When working with bare hands, it is a good plan to cover the dynamite with the original paper wrappers of the cartridges to prevent absorption of nitroglycerin by the pores. This paper also protects the dynamite against the water in the mudcap. A blasting cap crimped on to fuse should be placed in the middle of the charge, and the whole covered with six inches of damp clay or sand. The idea is to get the mass of explosive in direct contact with the boulder and exclude all air cushions. The mud or damp sand should be pressed firmly over the mass of dynamite, care being taken not to cover the outer end of the fuse. If the boulder is deeply imbedded in the ground, it is best, before blasting, to dig away or loosen some of the earth surrounding it.

Blockholing

This is the most economical way to use dynamite in breaking up boulders, although it takes some time and labor to drill the one or more necessary holes in the boulder. The holes in large boulders should be an inch or more in diameter, while three-quarters or seven-eighths of an inch will answer for the smaller ones.

A boulder weighing from eight to ten tons can be well broken by drilling a one-inch hole in it near the center from two to three feet deep as the shape and grain of the rock may demand, and exploding in the hole four to five one and one-quarter by eight-inch cartridges of Red Cross Extra Dynamite 40%. The dynamite should be poured out of the paper shells and packed down into the hole with a stick. When it is all in place a hole is made in it with a sharp stick and the blasting cap, crimped to the necessary length of fuse, is pushed down into this hole and held in position by carefully packing any clay tamping there is room for about the fuse.

To break up a boulder weighing approximately a ton, a one-inch hole eight inches deep, charged from half to two-thirds full of Red Cross Extra Dynamite, is required. Smaller boulders require holes from four to six inches in depth, which, if necessary, can be filled full of Red Cross Extra Dynamite, and no tamping used.

Snakeholing

In this method of breaking boulders the dynamite is placed in holes underneath them just as in stump blasting. The hole is made with a crowbar or dirt auger in such a direction that the charge of dynamite will be against the center of the lower side of the boulder. If the boulder is hollow or flat underneath, the explosion of the charge will break it in pieces and throw it out of its bed. If the lower side is round or bulging the boulder will be heaved out, but will not be so well broken. When this occurs the large pieces may be broken by mudcapping. Care should be taken when the charge is placed to leave no means by which the force of the dynamite may be wasted. If it has not been thoroughly tamped, or if it is too near the surface of the ground and not in the proper position beneath the boulder, the dynamite may blow the dirt out and leave the boulder untouched.

Red Cross 40% Extra Dynamite should be used when breaking up boulders in this way. Only from one-half to two-thirds the quantity that would be required to mudcap the same boulder is needed, provided it has a hollow or flat side underneath. Less dynamite is required in damp, heavy soil than in light or sandy soil.

Caution: Blockholing and snakeholing boulders are the most dangerous operations in agricultural blasting, because pieces of rock are often thrown great distances. Hence it is necessary to get 300 to 400 feet away before the blast. To reduce the risk from flying stones, especially when blasting near a dwelling, cover the boulder with a number of leafy, branchy boughs. These tend to retard the flying stones the same as the rope blankets used by contractors in blasting in cities.

The quantity and strength of dynamite required naturally depends on the size and shape of the boulder. The "grain" and kind of rock are also important points. Red Cross Extra Dynamite 40% or Du Pont 60% N. G. Dynamite is best for blasting boulders. The following table gives approximately the number of 1¼ x 8-inch cartridges to blast boulders of different sizes, so that they will be broken into pieces small enough for one man to handle, provided the boulders are mostly above the surface of the ground.

Table of Charges for Boulder Blasting

Weight of Boulder	Approximate Number of 1¼"x8" Cartridges Required for:		
	Mudcapping	Snakeholing	Blockholing
100 lbs. to 500 lbs.	½ to 1½	½ to 1	¼
1000 lbs.	2	1½	½
2000 lbs.	3	2½	⅔
3000 lbs.	3½	3	1
4000 lbs.	4	3½	1¼
5000 lbs.	4½	4	1¾
7500 lbs.	6	5	2½
10000 lbs.	8	6	3½

If boulders are largely buried in the ground they may be broken by doubling or trebling the above charges, but it is generally less expensive under these conditions to lift the boulder out of the ground by snakeholing and then if it is too large to handle, to break it in pieces by mudcapping. For lifting without breaking, the charges in above table may be approximately reduced one-half.

Ditching

When properly used dynamite will excavate ditches entirely, spreading the earth over the land some distance away. In the same way much valuable land can be saved by blasting straight channels to straighten and shorten the course of creeks and streams. It is not necessary in this work to blast a large ditch or channel, for if the current is once started through a small one it will soon wash it out to the proper size.

Ditches can be dug economically and satisfactorily either through dry ground, or in wet heavy soil, even though it should be covered with several inches of water. The best and most systematic way of doing this class of work is to:

(1) Stake out and measure the entire length of the ditch required.

(2) Multiply the total length in feet by 12 inches and divide by 28 in order to ascertain the number of holes to be punched or bored. The divisor 28 is given to represent the normal distance between holes. In stiff clay or hardpan holes should be 26 to 28 inches apart. In loose or mucky soil where there will be a good flow of water to clean out bottom, holes may be 30 inches apart.

(3) Carry the necessary number of Red Cross Extra 20% cartridges required (one or two per hole according to conditions), as also the number of Victor No. 6 Electric Fuzes with wires the required length according to the depth and spacing of the holes (one fuze to each hole), to where the work is to be done.

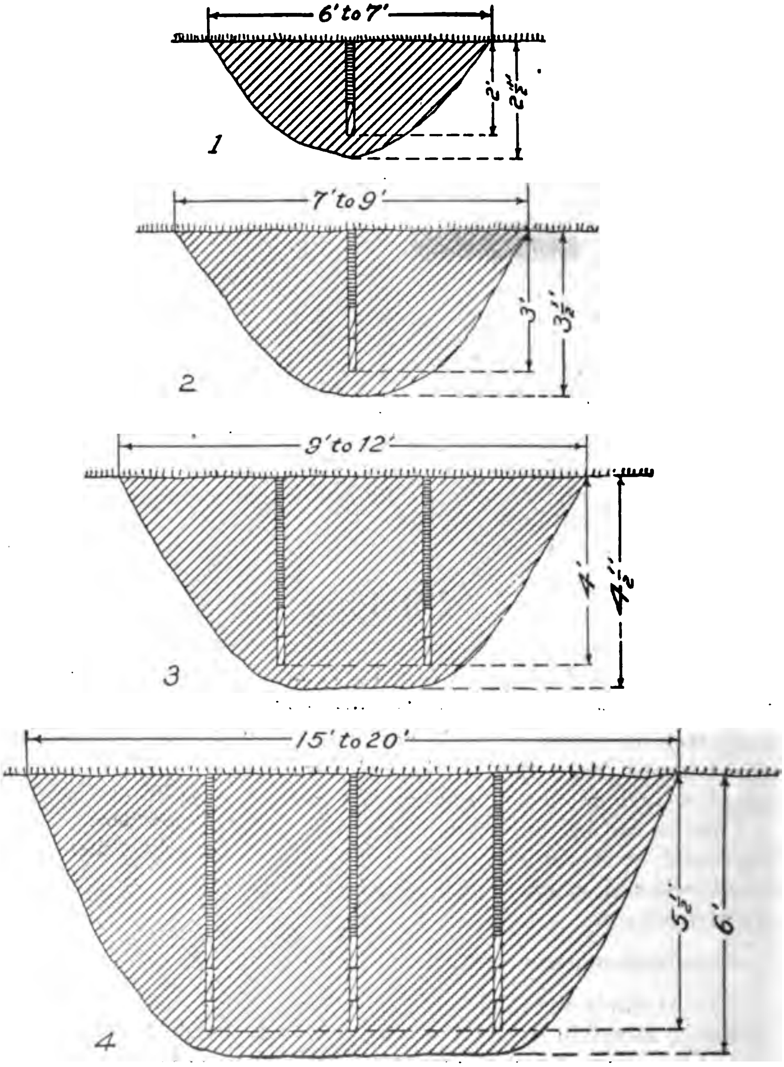


FIG. 131

Diagram showing approximate cross-section of blasted ditches with location and amount of charge required. No. 1 shows 1 cartridge tamped in, No. 2 two cartridges, No. 3 two cartridges in each of two holes, No. 4 three cartridges in each of three holes.

(4) Prepare as many primers as there are holes required. Primers should be made in accordance with the instructions contained on page — using for this purpose one Victor No. 6 Electric Fuze.

(5) Punch or bore a row of holes along the center line where the ditch has to be made. Holes should be made vertically with a bar not less than one and one-half inches in diameter, spaced 28 inches apart, and sunk to a depth approximately within 6 inches of the desired depth of the ditch. The number of holes bored for each blast should be consistent with the capacity of the blasting machine to be used.

(6) If the work is dry, charge the holes after they have all been bored to save time. If a charge of more than one cartridge is required, place the primed cartridge in last, and tamp well to top of the ground.

If the work is in very wet or swamp soil it is very often advisable to load the holes as soon as bored as wet shifting soil may refill the hole. No tamping is required if cartridges are well covered with water.

(7) Connect electric fuze wires in one of the ways illustrated on page 146.

(8) As soon as the last hole is charged stretch out leading wire and connect same to electric fuze wires, caution everyone to retire and when certain that every one is at a safe distance away connect leading wire to blasting machine and fire. *Never connect leading wire to blasting machine until ready to fire.*

In this way ditches can be dug up to 9 feet wide at the top, 3 feet wide at the bottom and 4½ feet deep for approximately 6c. per lineal foot or 8c. per cubic yard. The top width depends on the depth, size of the charge, kind of soil and consistency of same. When digging ditches requiring a width of from 9 to 20 feet, two or three rows of holes are necessary. The holes should be the same distance apart in the rows, the same depth and charged with the same quantity and kind of dynamite as for the narrower ditches.

Note: If in doubt as to the proper depth of holes or charge, try a short test blast of five to ten holes.

If the first hole in the second or succeeding sections is spaced the regular 26 or 28 inches away from the end of the first blast, a ridge will be left at that point in the finished ditch. To overcome this, place the first charge in each string not more than a few inches away from the end of the last blasted section.

In heavy dry soil it may prove advantageous to load at the bottom of each hole one cartridge of Red Cross Extra 40% Dynamite, underneath the 20% load, the idea being that the weaker dynamite will break the upper soil and the 40% will then throw it out better than if 20% were used exclusively. It must be remembered that the kind and condition of the soil greatly affect the work, hence no hard and fast rules can apply.

In strongly sodded soil, cutting the sod with a spade along the proposed sides of the ditch help to produce a clean excavation.

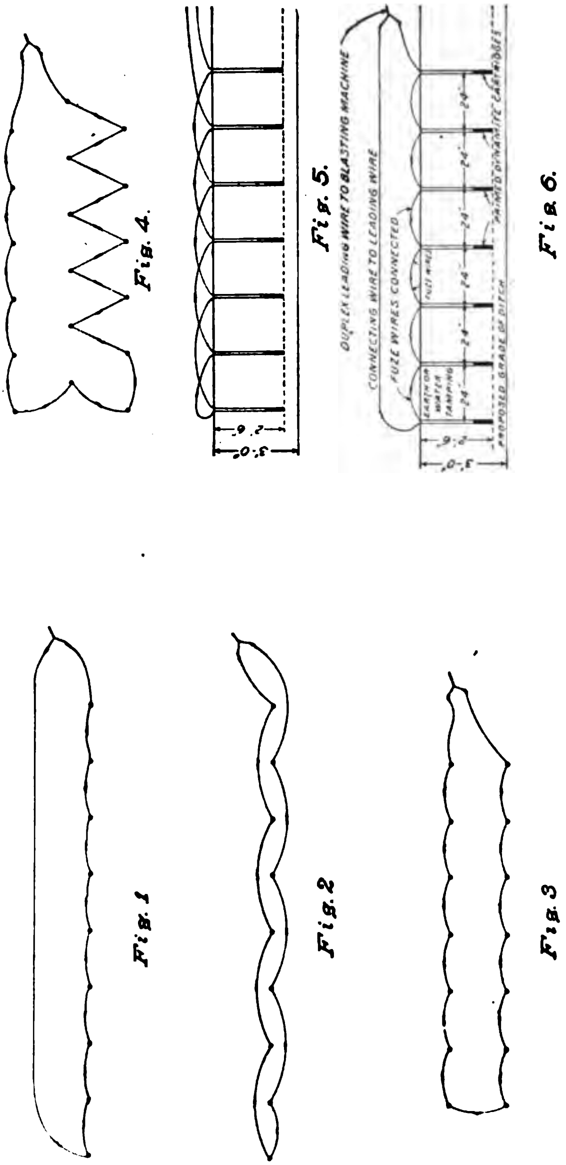


Fig. 1 Fig. 2 Fig. 3 Fig. 4 Fig. 5. Fig. 6.

FIG. 132.—SHOWING ELECTRIC CONNECTIONS FOR BLASTING DITCHES

Fig. 1 shows method of connecting single row of holes when the fuze wires are short, the leading wire being connected to the two ends of the series. Fig. 2 shows a method requiring less leading wire, both wires of the duplex leading wire being connected to separate fuze wires at one end of the series. Fig. 3 shows connections for a two-row blast, Fig. 4 for a three-row blast, Fig. 5 shows a vertical view of Fig. 2 connections, and Fig. 6 a vertical view of Fig. 1 connections.

Table of Charges for Ditch Blasting

Approximate top width of ditch in feet.	Approximate No. of ctgs. required for various depths.			No. of rows of holes required.	Distance between rows.
	2½ to 3 ft.	4	5 to 6 ft.		
3	½			1	0 inches
6	1	2	3	1	0 "
8	1	2	3	2	20 "
10	1	2	3	2	28 "
12	1	2	3	2	36 "
14	1	2	3	2	42 "
16	1	2	3	3	42 "
Required length of No. 6 Victor Electric Fuzes.	4 ft.	6 ft.	6 to 8 ft.		

Blasting Ditches Without a Blasting Machine

There are occasions when a ditch has to be cut through very swampy and untrafficable muck, which makes it very difficult for the blaster to conveniently carry out all the work necessary when the blasting machine has to be used. Then again in the same soil it may be imperative to cut a ditch 300 to 500 feet in length in one blast, which cannot be done by means of a blasting machine, as a blasting machine will fire from 30 to 250 feet at one time according to its size. When this occurs the following method should be adopted:

Punch or bore a row of holes vertically along the center line of the proposed ditch with a bar not less than 1½ inches in diameter, down to a depth approximately within 6 inches of the desired depth of the ditch, spacing them from 18 to 24 inches apart. Each hole should be charged, as soon as made, with one or more cartridges of Du Pont N. G. 60% Dynamite according to depth, as soon as bored. Place in the center hole one extra cartridge primed with a blasting cap carefully crimped to the proper length of waterproof fuse. No tamping is needed provided mud or water covers the charge. The primed cartridge should not be loaded until everybody except the blaster has retired to a considerable distance from the line of the ditch in order to avoid the great amount of dirt thrown out around that vicinity. The primer fuse should be lighted just as soon as possible after the primer is loaded, the blaster, of course, retiring to a safe distance. The charge in the middle hole explodes those in the holes on either side, and the effect of these two is carried to the next and so on almost instantaneously to the ends of the ditch.

Due to the fact that the closer spacing of holes and more expensive dynamite are required, this method is usually somewhat more expensive than when the electrical method is employed. It must be remembered that cold weather checks the action of Du Pont N. G. 60% Dynamite and it is necessary to use larger charges and put the holes closer together than in warm weather. This work can be done best when the temperature of the water or earth is above 50 degrees Fahr., and is not recommended for lower temperatures.

For ditches with a width at the top greater than 6 feet two or three rows of holes are required. The holes should be the same distance apart in the rows, the same depth and charged with the same quantity and kind of dynamite as for narrower ditches. The following table shows the spacing of the rows and charge per hole required for various size ditches:

Table of Charges for Blasting Ditch Without a Blasting Machine

Top width of ditch	Approximate number of cartridges per hole required for various depths				Number of rows required	Distance between rows in inches
	2½ to 3 ft.	4 ft.	5 ft.	6 ft.		
6	1	2	2½	3	1	--
8	1	2	2½	3	2	30
10	1	2	2½	3	2	36
12	1	2	2½	3	2	42
14	1	2	2½	3	2	48
16	1	2	2½	3	3	36
18	1	2	2½	3	3	42
20	1	2	2½	3	3	48

In order to enable the blaster to calculate the amount of dynamite required to cut various size ditches, the following table used in conjunction with either of the preceding tables should prove very useful:

Spacing	10 Rods			¼ Mile			½ Mile		
	Number of holes	Dynamite required using charges per hole of		Number of holes	Dynamite required using charges per hole of		Number of holes	Dynamite required using charges per hole of	
		½ cartridge	Whole cartridge		½ cartridge	Whole cartridge		½ cartridge	Whole cartridge
18 ins.	110	28 lbs.	55 lbs.	880	220 lbs.	440 lbs.	1760	440 lbs.	880 lbs.
20 "	99	25 "	49 "	792	198 "	396 "	1584	396 "	792 "
24 "	83	21 "	41 "	664	166 "	332 "	1328	332 "	664 "
26 "	76	19 "	38 "	608	152 "	304 "	1216	304 "	608 "
28 "	71	18 "	36 "	566	142 "	284 "	1132	283 "	566 "

1 rod = 16½ feet.
10 rods = 165 feet or 55 yards.
¼ mile = 1320 feet or 440 yards or 80 rods.
½ mile = 2640 feet or 880 yards or 160 rods.

If longer ditches or larger charges are required, multiply the above figures by two, three or four, according to the number of rows.

Note: In case of doubt as to proper distance between holes or rows, or depth and strength of charges, try several 10-hole test blasts, with different charges at different distances and depths.

When wide ditches are blasted requiring two or three rows of holes, the center hole in each of the rows should be primed with a Victor No. 6 Electric Fuze. These should be connected together and fired by means of a blasting machine. In some cases, when the rows are not more than 36 inches apart, the blast can be effectually made by placing extra holes between the rows midway between the two center holes. The primed cartridge with cap and fuse is then inserted in the center hole of the middle row; the detonation then will carry by means of the extra holes to the other rows already charged as shown in the diagram below.

Note: *Wasting of earth.* The dirt excavated in a ditch blast will fall the way the wind blows. It is better to ditch on a windy day to obviate the possibility of dirt falling back into the ditch.

o o o o o o o o o o o o o
o <——EXTRA HOLE FOR PRIMER
o o o o o o o o o o o o o

---

o o o o o o o o o o o
o <—EXTRA HOLE FOR CARRYING DETONATION
o o o o o o o o o o
o <—EXTRA HOLE FOR CARRYING DETONATION
o o o o o o o o o o o

SHOWING LOCATION OF PRIMER HOLES IN PROPAGATED BLASTING OF DITCHES

Draining Swamps and Ponds

Swamps and ponds, except where they are close to rivers, lakes or the ocean, are caused by spring or surface water collecting on low ground without a lower outlet. As a rule they are underlaid by a hard clay or other impervious subsoils which prevent the water from sinking. In a great many instances it is impracticable to drain these by surface methods or ditching, yet they can often be permanently dried up by exploding deep charges of dynamite and shattering the impervious subsoil beneath. The number of charges required and depth of same depend of course on the size of area to be drained, the amount of water required to be sunk, and the thickness of the various subsoil strata encountered until the water-absorbing sand or gravel is reached. In order to determine the depth required, a test hole is bored with a dirt auger, which should be pulled up from time to time in order to clean hole out, as also to ascertain the nature of the soil encountered which is readily seen on the spiral thread of the auger. Once the water-absorbing sand or gravel is reached the depth of the hole is noted on the auger shank. This test hole must not be charged, as it is too deep. The hole or holes for charging should stop about 6 inches above the sand or gravel in shallow holes, and 12 to 18 inches in deep holes. It very often happens that holes have to be bored to depths averaging from 15 to 30 feet before the water-absorbing strata are reached and in order to do this it is necessary to use an extension auger. If the place where the holes are to be put down is covered with water too deep to work in, the boring should be done from a raft anchored in the proper position. It is much easier to operate the auger through a hole in the center of the raft than over the side. As soon as the hole has been bored to the required depth the auger is withdrawn and a piece of 1½-inch pipe sufficiently long to reach the bottom of same and 5 or 6 inches above the water level is inserted. Through this the dynamite cartridges are dropped one at a time and pushed to the bottom with a wooden tamping rod. A good firm push will hold each cartridge in position. The last cartridge but one is primed with a Victor Waterproof Electric Fuze and one cartridge is put on top of it to hold same in place, as it is not advisable to give the primed cartridge too hard a push with the tamping rod.

When the hole has been charged the loading pipe is withdrawn and slipped over the ends of the electric fuze wires, the leading wires are connected on to the electric fuze wires, the joints being carefully protected with insulating tape and the raft is poled to the shore or a safe distance away from the hole while the leading wire is carefully paid out. The outer ends of the leading wires are then attached to the blasting machine, the operation of which explodes the charge. It is unnecessary to do any tamping in this work if the holes are filled with water. The cartridges should not be slit. The explosive to use is Red Cross Extra Dynamite 40%. The following table gives the approximate charge for holes of different depths:

Depth of Hole.	Approximate Number of 1¼" x 8" Cartridges.
5 ft.	4.
10 ft.	7
15 ft.	12
20 ft.	17
30 ft.	25
40 ft.	35

Where the ground is swampy or ponds form in the wet season only and dry up later in the year, the blasting should be done in the dry season when a raft will not be required. This blasting should be done just as described above except that it is necessary to tamp the charge thoroughly unless the borehole fills up with water. In this work it is sometimes of advantage to make a chamber in the bottom of the hole by first exploding a single cartridge in the bottom. This makes it possible to get more of the main charge into the bottom and break the rock or subsoil better. The explosion of the single cartridge may close the hole a little, but it can easily be opened again with the auger or an iron rod. The main charge must never be loaded immediately after chambering, but a half hour or more allowed for the bottom of the borehole to cool off. This plan of chambering the bottom may also be followed when water fills the bore holes.

As the movement of water into this hole tends to carry dissolved clay with it, which may eventually form an impervious coating over the sand or gravel at the bottom and thus stop the drainage, it is advisable to guard against this by filling the hole with coarse material immediately after the blast.

Have ready, 15 or 20 feet from the proposed hole, a pile of rubbish such as pieces of corn stalks, cotton stalks, small pieces of stump wood and a few forkfuls of hay or straw. Dump the rubbish into the blasted hole, being careful not to clog it. Poke it down with a pole, then put the hay or straw on top, filling in the last few feet with heavy chunks of earth. Such a filled hole should establish permanent drainage.

See pages 119 to 126 for proper methods of priming, charging, tamping and firing.

Road Building

Road grading and ditching always take more or less digging, but by using dynamite to loosen up the hard ground or shale, and to blast out the rock, roads can be built quickly and at reduced expense.

To blast cuts not more than five feet deep through hard earth or shale a bar should be driven down to grade and two or three 1¼ x 8-inch cartridges of Red Cross Extra Dynamite 40% exploded in the hole thus made. Be sure to first tamp the charge properly. Holes should be spaced five to eight feet apart. In this way the material to be removed is not only broken up so that it can be shoveled very easily, but a good portion of it is spread over the surrounding land and does not have to be handled.

Roads can be ditched with but little shoveling, by exploding about half a cartridge of the same kind of dynamite in holes along the sides a foot deep and two to three feet apart.

If it is necessary to cut through rock, the holes should be drilled closer together and charged heavier. See pages 119 to 126 for proper methods of priming, charging, tamping and firing.

Excavating Cellars

If the work is in rock, drill the holes four feet deep and two and a half to three feet apart. Charge with one or one and a half 1¼ x 8-inch cartridges of Red Cross Extra Dynamite 40%. As hand drills are not often larger than one inch in diameter, it will be necessary to pour the dynamite out of the shells and pack it in the bottoms of the holes with a wooden stick exactly as when blockholing a boulder as already described. The priming and tamping are also done as when blockholing boulders. After one cut or bench has been taken out in part or over the entire surface of the cellar or trench, the second cut of three or four feet may be commenced and the excavating continued in this way until the proper depth is reached.

When the cellar foundations are to be in earth or shale the blasting is done as in road grading already described. A small shallow cellar not larger than fifteen by twenty feet nor deeper than four feet can be economically excavated in earth almost entirely and with practically no shoveling by drilling holes three feet apart each way, and three feet nine inches deep and loading in each hole two 1¼ x 8-inch cartridges of Red Cross Extra Dynamite 20%. The explosion spreads practically all of the material excavated over the adjacent ground for some distance.

The charges should each be primed with an electric fuze, should be well tamped, and all exploded together with a Reliable Blasting Machine. See pages 119 to 126 for proper methods of priming, charging, tamping and firing.

Sinking Wells

Wells are generally sunk through rock or ground which cannot be dug to advantage without the aid of explosives. In well sinking when rock is reached and the earth or sand above is properly supported, a circle of four or five drill holes should be started about half-way between the center and the sides of the well and pointed at such an angle that they will come closer together near the center when they are three or four feet deep. These holes should be loaded about half full of Red Cross Extra Dynamite 40%, with damp clay or sand tamping packed firmly above to the top of the hole and then exploded all together from the surface by electricity. The result of this shot will be to blow out a funnel-shaped opening in the center, and the bottom can then be squared up with another circle of holes drilled straight down as close to the sides as possible. If the well is large it may be necessary to drill a circle of holes between the inner and outer circle. The above process should be repeated until the well has passed through the rock or has been sunk to the necessary depth. Do not in any case enter a well until all the fumes of the last blast have come out. If in doubt, lower a lighted candle to the bottom, if it continues to burn the well may be entered safely. See pages 119 to 126 for proper methods of priming, charging, tamping and firing.

Digging Post Holes

Only enough dynamite should be used in this work to make the digging easy because larger charges loosen the ground to such an extent that it is difficult to make the poles or posts as firm as they should be. This applies particularly to large poles.

To do this blasting a hole is bored into the ground within 6 inches of the desired depth of the hole. In the bottom of this hole from one-quarter to a whole cartridge of Red Cross Extra Dynamite 40% is exploded. No tamping should be done as this would cause the dynamite to loosen the surrounding ground too much.

Shattering Subsoil and Hardpan

Plowing and cropping the same soil year after year robs the topsoil of many of its original crop-bearing properties. Deep plowing as a rule is the remedy for soil deterioration. When a subsoil plow is used a noticeable increase in the crops is obtained although the soil is only indifferently broken up to a maximum depth of 18 inches. How much more then may be expected if 4 or 5 feet of virgin soil is rendered porous and mellow! Red Cross Extra Dynamite accomplishes this, as it thoroughly breaks up and shatters the hardpan, or hard impervious clay to this depth. It aerates same and places at the disposal of plant life an enlarged moisture reservoir and all the soluble fertilizing mineral elements contained in that virgin ground.

In doing this work the greatest efficiency is obtained by boring holes at intervals of 15 to 20 feet to a depth of 3 to 4 feet according to thickness of the clay subsoil. Each hole is charged with one-half of a 1¼ x 8-inch cartridge of Red Cross Extra Dynamite 20%, primed with cap and fuse. After the charge is placed, holes are tamped as compactly as possible up to the surface. The tighter the tamping is done the better will the results be and it is very important that this be done properly in order to minimize as much as possible the effect of the explosion on the surface soil. See page 122.

When blasting hardpan the holes should be bored to within about six inches of the bottom of the hardpan and the charge of dynamite placed at that point, the object being to shatter the greatest area possible and not to merely make a chamber in the ground under the hardpan. The spacing of holes should be somewhat closer and charge of dynamite should be somewhat heavier than when blasting ordinary subsoil. When the hardpan is thin, six to twelve inches, the charge should be not more than half a cartridge placed in the middle of the hardpan.

In some kinds of hardpan, like cemented gravel, it may be necessary to vary a little the instructions given above. These instructions will, however, answer for a guide until practice shows that some slight changes in the way of blasting these irregular hardpans will prove of advantage. If properly done, it may not be necessary to blast subsoil or hardpan more often than once in ten years. In orchards in California hardpan, heavier charges are sometimes used in the boreholes so that the blast will leave a considerable opening, which can be filled with special fertilizers. *Subsoil blasting should be done only when the ground is dry because wet subsoil is not easily cracked and shattered, and tends to come up on top, leaving a large hole where each blast was fired.*

Tree Planting

The method to be employed in doing this work is to punch a hole in the ground at the point selected for planting the tree, to a depth of two to five feet according to nature of soil, and location of hardpan, if any.

In very tight soils, as in California hardpan a whole cartridge of Red Cross Extra 20% or even 40% may be necessary. These heavy charges should be tamped.

The usual charge is one-half cartridge of Red Cross Extra Dynamite 20% per hole, primed with cap and fuse. If the soil in which the tree is to be planted is of a hardpan, shale or very compact clay, holes should be tamped, as also in the case when pecan trees are planted, otherwise no tamping is necessary.

The common practice is to plant the trees shortly after the holes are blasted. Some orchardists, however, believe best results will be obtained when holes for Spring planting are blasted in the Fall.

This affords about six months time for the air, moisture and sunlight to work on the subsoil and mellow it.

If trees are planted immediately after the blast, care must be taken to poke down the upheaved soil at the bottom of the hole or settle it well with water. If this is not done, the dirt may shrink away from the roots of the tree, leaving is suspended in air or water and thus killing it. This is undoubtedly the cause of the death of the few dynamite-set trees reported as failures. A little care in settling the dirt will prevent this trouble.

Table of Charges and Amount of Red Cross Extra Dynamite 20% Required per Acre for Planting Trees

Distance between trees, square method.	Trees per acre.	Amount of dynamite per acre, using ½ cart. per tree.	No. 6 Blasting Caps, per acre.	*Fuse per acre, 2½ ft. per tree.
15 ft.	196	49 lbs.	196	490 ft.
20 "	110	28 "	110	275 "
30 "	49	13 "	49	122 "
40 "	25	7 "	25	63 "

*It is necessary to have as many feet of fuse per hole as the hole is deep.

Cultivating or Rejuvenating Old Fruit Trees, Grape Vines, Etc.

The principal objects to be attained by using dynamite in cultivating or rejuvenating old fruit and other trees, grapevines, etc., is to open up the subsoil so that the roots may spread farther and go deeper and also so as to increase the waterholding capacity of the soil, to prevent the surplus moisture from lying on or near to the surface. This work is, therefore, very much like subsoil or hardpan blasting, especially in such places where resistant soil conditions are encountered.

In California and other States, where many orchards grow over hardpan, holes are often drilled from 3 to 5 feet deep and sometimes placed only 6 feet away from the trees. When holes are within 6 feet of the trees, the charge is reduced.

It is not often advisable to blast with large charges or so close to the tree that many of the roots will be broken. When this occurs it is necessary to prune the top of the tree so that the transpiration will properly correspond with the feeding. Do not fail to carry out the priming, charging and tamping instructions as contained on pages 119 to 126.

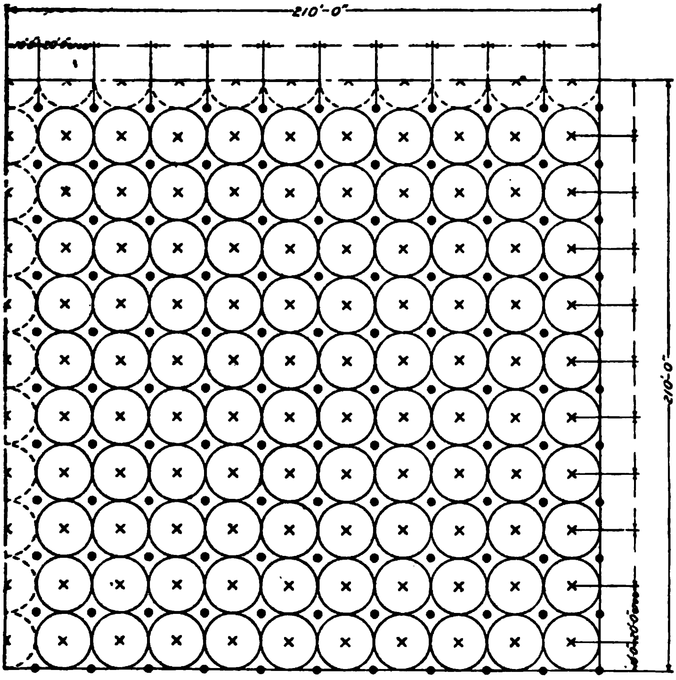


FIG. 133

This diagram represents a square acre, approximately, with trees growing at 20 feet distances "on the square." The black dots represent the trees, the crosses the blasts, and the circles the areas broken by the blasts. This system, with holes punched in the centers of the squares is the best when trees are spaced up to twenty feet apart. As 20-feet spacing does not exactly cover a square acre half the effect of the blasts on two sides of the acre will be in the two adjacent acres.

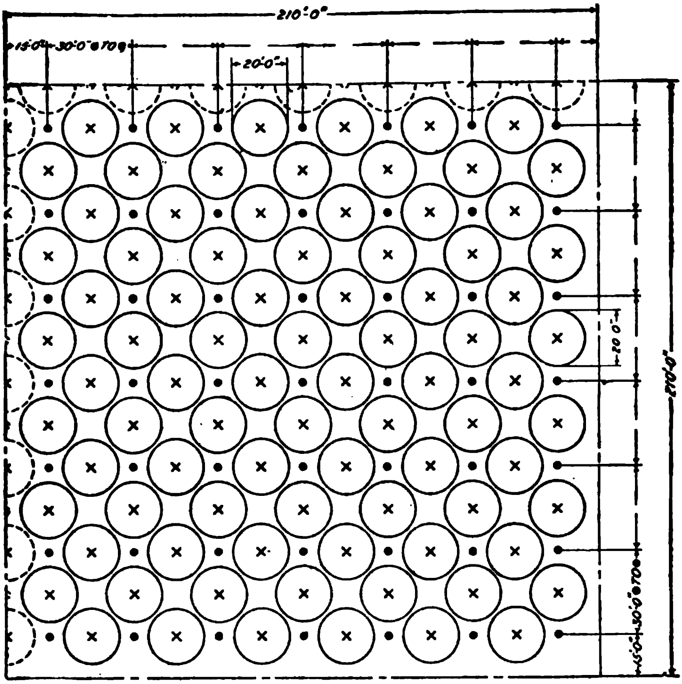


FIG. 134

This represents a square acre of orchard set on the 30 feet square plan. with blasts between the trees. This system is best where trees are from 20 to 30 feet apart.

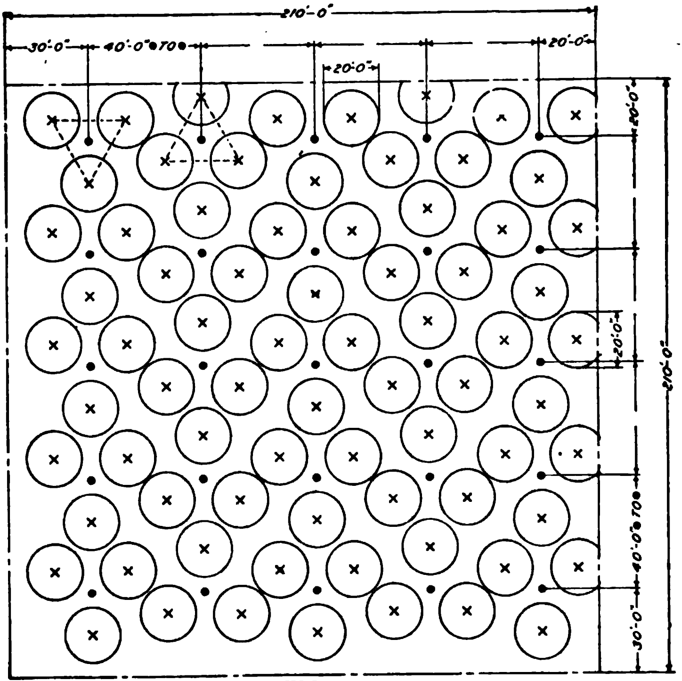


FIG. 135

This represents a square acre of orchard set on the 40 feet square plan, with blasts on three sides of each tree. The holes are punched at the apexes of an equilateral triangle, the tree being in the center and the apexes at 10 feet distances from the tree. As shown, the triangles for two adjacent rows should point in opposite directions to distribute the blasting to best advantage. This method is best when trees are more than 30 feet apart.

Table of Charges and Amount of Red Cross Extra Dynamite Required per Acre for Orchard Rejuvenation

Distance between trees, square method.	Trees per acre.	Location of holes for Dynamite.	Number of holes per acre.	Pounds of Red Cross Extra Dynamite per acre using ½ Cartridge per hole.
15 ft.	196	Midway between on diagonal lines.	198	49
20 ft.	110	"	110	28
20 ft.	110	Midway between on square lines.	210	53
30 ft.	49	"	91	23
30 ft.	49	Ten feet from tree on three sides.	147	37
40 ft.	25	"	75	19

Blasting Ice

Ice gorges may often be prevented by shattering the large floating cakes with Red Cross Extra Dynamite 40% so that they will not lodge at dams or in the narrow parts of the stream. To break these cakes several cartridges of the dynamite tied together in a bundle are laid on the ice and exploded. This is repeated until the cake is thoroughly shattered and broken up. The size of the charge and the number of times the blasting must be repeated depend altogether on the thickness of the ice and the size of the cake. One cartridge of the bundle is primed with blasting cap and fuse, but before this the dynamite must be thoroughly thawed and kept thawed until it is laid on the ice. This blasting can be done best along broad, slow-moving parts of the stream where it is easy to get on to the ice cakes either from the shore or from boats. When the streams are narrow the charges of dynamite may be thrown on to the ice from the shores, or, if the ice is running swiftly, they may be dropped on to the cakes from the downstream side of bridges. When the charges consisting of two or more cartridges tied together in a bundle are to be thrown on to the floating ice either from bridges or the shore a block of wood, piece of board or something of that kind should be tied to the charge to keep it from rolling out of position after it lands on the ice. As it is necessary when blasting ice in this way to light the fuse while the dynamite is in the hands of the blaster, particular attention must be given to having the fuse plenty long enough and the charge must be thrown just as soon as the fuse is lighted.

The following table gives the approximate quantity of Red Cross Extra Dynamite 40% required to break floating ice cakes of different thickness when the dynamite is exploded on the surface of the ice. The number of charges necessary depends on the size and extent of the ice cake:

Thickness of Ice Cakes.	Approximate No. of 1¼″ x 8″ Cartridges.
12 in.	2 to 3
24 in.	6 to 8
36 in.	10 to 12

To open ice gorges already formed, a channel should be cut through them beginning on the down-stream side and working up stream along the line of the strongest current. In large streams this channel should be about fifty feet wide, and if the gorge does not move after the channel has been cut through, it will then be necessary to begin at the down-stream side of the gorge again and widen the channel until the ice has been carried away.

To make the channel, holes are cut with an axe, bar or ice spade through the ice twenty to thirty feet apart. These holes are laid out in a semi-circle with the two end holes about twenty to thirty feet back from the open water and fifty feet apart.

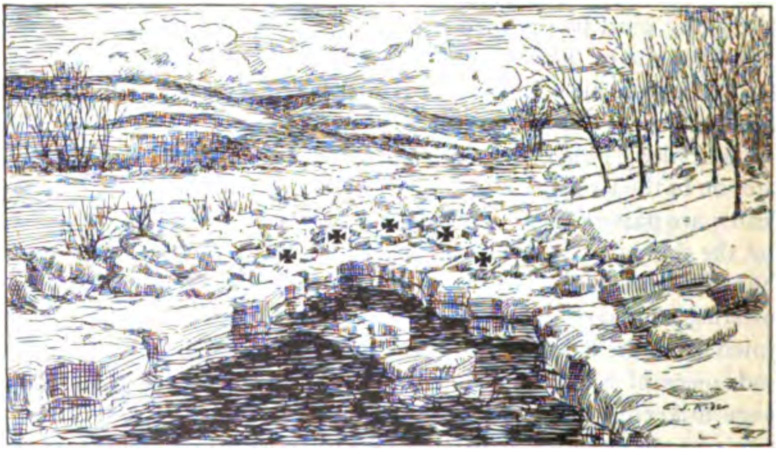


FIG. 136.—DIAGRAM SHOWING LOCATION OF ROW OF HOLES FOR BLASTING AN ICE GORGE

The charge consists of several 1¼ x 8-inch cartridges of Red Cross Extra Dynamite 40%, tied securely together with string, one of the cartridges having been primed with a Victor Waterproof Electric Fuze. When the charges for all of the holes are prepared they are connected together and to the leading wires. Each charge is then lowered by the electric fuze wires into the water and pushed under the down-stream ice with the tamping stick. If the current is strong enough to carry the charge down stream the electric fuze wires should be long enough to let it float six or eight feet below the holes. In a slow current a block of light wood may be fastened to each bundle of cartridges to make it float against under side of ice. The explosion of all of these charges simultaneously by the operation of the blasting machine will break up the first fifty or sixty feet of the channel and the broken ice will immediately float away unless the current of the stream is very sluggish. In that case the broken ice should be pushed out with poles into open water, before it has time to freeze in place again. This same operation is repeated cutting out fifty or sixty feet or more of the channel with each blast until the gorge has been cut through. If the ice is from two to four feet thick the charge in each hole should be from two to five 1¼ x 8-inch cartridges of Red Cross Extra Dynamite 40%. In ice six to eight feet thick, each charge must be increased to ten or twelve cartridges. When the ice is thick, and large charges are necessary, the holes have to be from six to twelve inches in diameter in order to get the bundle of cartridges through them. These large holes can be cut through the ice more easily by exploding half cartridges of the dynamite in small holes made with bars.

In this work particular attention should be given to having the dynamite in a well-thawed and soft condition when it is used, and to guard against breaking insulation of fuze wires or withdrawal of fuzes by the pull of the current.

Ice is blasted from watering places for stock either by exploding the dynamite on the ice or in the water under the ice. See pages 119 to 126 for proper methods of priming, charging, tamping and firing.

Starting Log Jams

To start log jams with dynamite the charge of several cartridges or in some instances of many pounds of dynamite is exploded on or under the logs forming the key of the jam. When small charges are enough, the cartridges are tied in a bundle as when blasting ice. If charges of fifty pounds or more are necessary the dynamite may be put in a bag or left in the original wooden cases. The charge is primed with a Victor Waterproof Electric Fuze and after being firmly secured in the proper position is exploded from the shore with a blasting machine.

Blocks in log rollways caused by rain and snow freezing and binding the logs together are broken up by exploding charges of dynamite in different places under the logs until they are loosened and can be rolled apart.

Red Cross Extra Dynamite 40% is recommended for starting log jams and for opening the rollways. See pages 119 to 126 for proper methods of priming, charging, tamping and firing.

WHAT TO DO WHEN WANTING DYNAMITE

In the foregoing, Red Cross Extra Dynamite and Du Pont Blasting Supplies have been carefully described, and the way to store and use them explained. When blasting is contemplated refer to the section on the kind of work to be done and find the kind of dynamite recommended for that work and about how much will be required.

If the dynamite is to be used for blasting stumps, multiply the number of stumps to be blasted by the number of cartridges for a stump the size they will average and divide the number of cartridges by two to get the number of pounds required.

We prefer to sell through local dealers when possible. If we have a representative in your locality carrying stock, your order will be forwarded to him to be filled from his own stock. If we have no dealer nearby, we shall make shipment from our nearest distributing point, and if it is to be a charge account, the goods will be invoiced to the storekeeper who has agreed to carry your account, but shipment will be made direct to you.

You can buy any quantity of dynamite from one cartridge up from local dealers who have stock on hand, but on orders sent to this Company for direct shipment, broken lots cannot be purchased. The smallest direct shipment that we can accept for dynamite is 25 pounds; for caps, 100; for fuse, 100 feet. Orders for larger quantities must be in multiples of these figures; for instance, 50, 75, 100 and upwards pounds of dynamite; 100, 200, 300, etc., caps; 100, 200, 300, etc., feet of fuse.

The minimum freight charge is on the basis of 100 pounds; hence freight will be the same on 25, 50, 75 or 100 pounds.

As soon as you have sent in an order, be sure to notify your local freight agent, so that he may advise you promptly of the arrival of the shipment. It is required by law that explosives be removed from freight stations within 48 hours after their arrival. Order about 3 to 4 weeks before you need the dynamite and supplies.

Tear Out and Fill In Opposite Page When Ordering Supplies ☞

It is best to do this whether you can get them from your local dealer or not. Many of our dealers do not carry Blasting Supplies in stock, but will see that your order is filled. They need this written order. Even if the dealer carries a stock of Blasting Supplies, it is a great convenience for him to have this written order, and tends to prevent errors or omissions.

If we have no dealer in your locality send us the order and remittance and we will see that you are supplied.

E. I. du PONT de NEMOURS POWDER CO.,
Wilmington, Del.

New Farms For Old

There's a new, rich farm right under the old, worn-out one

You can bring the new one into use, and get largely increased crops by DEEP PLOWING WITH

DU PONT

RED CROSS LOW FREEZING DYNAMITE

DEEP PLOWING WITH DYNAMITE—LIGHTING THE FUSE

DEALERS WANTED EVERYWHERE

We want a dealer in every city, town and village not already covered. We request any hardware dealer or general store-keeper reading this booklet to mail the Card No. 3 on inside back cover, if he would like to consider our proposition to hand out our literature and take orders for our products for agricultural or other uses. He need not carry any stocks of our goods nor make any investment of capital to do this. His orders will be promptly filled from the nearest magazine.

◆

PROFESSIONAL BLASTERS CAN FIND PROFITABLE EMPLOYMENT ON FARMS

Threshermen and others doing farm work of various kinds at certain seasons of the year can obtain much profitable employment from farm owners by learning to do blasting for them in case they do not wish to do it themselves. We would take pleasure in instructing any man in methods of doing the work. For information on this subject, fill in and mail the Card No. 2 printed on the inside back cover.

THE LORD BALTIMORE PRESS, BALTIMORE, MD.

New Farms For Old

THROUGH

Deep Plowing

WITH

DU PONT

RED CROSS
LOW FREEZING
DYNAMITE

This booklet carries a new and wonderful message to every farmer

It tells the results of subsoiling with dynamite, which has been called

"GREATER THAN IRRIGATION"

Read every word of it. Then, if you are a progressive farmer, you will promptly take advantage of the opportunity herein set forth

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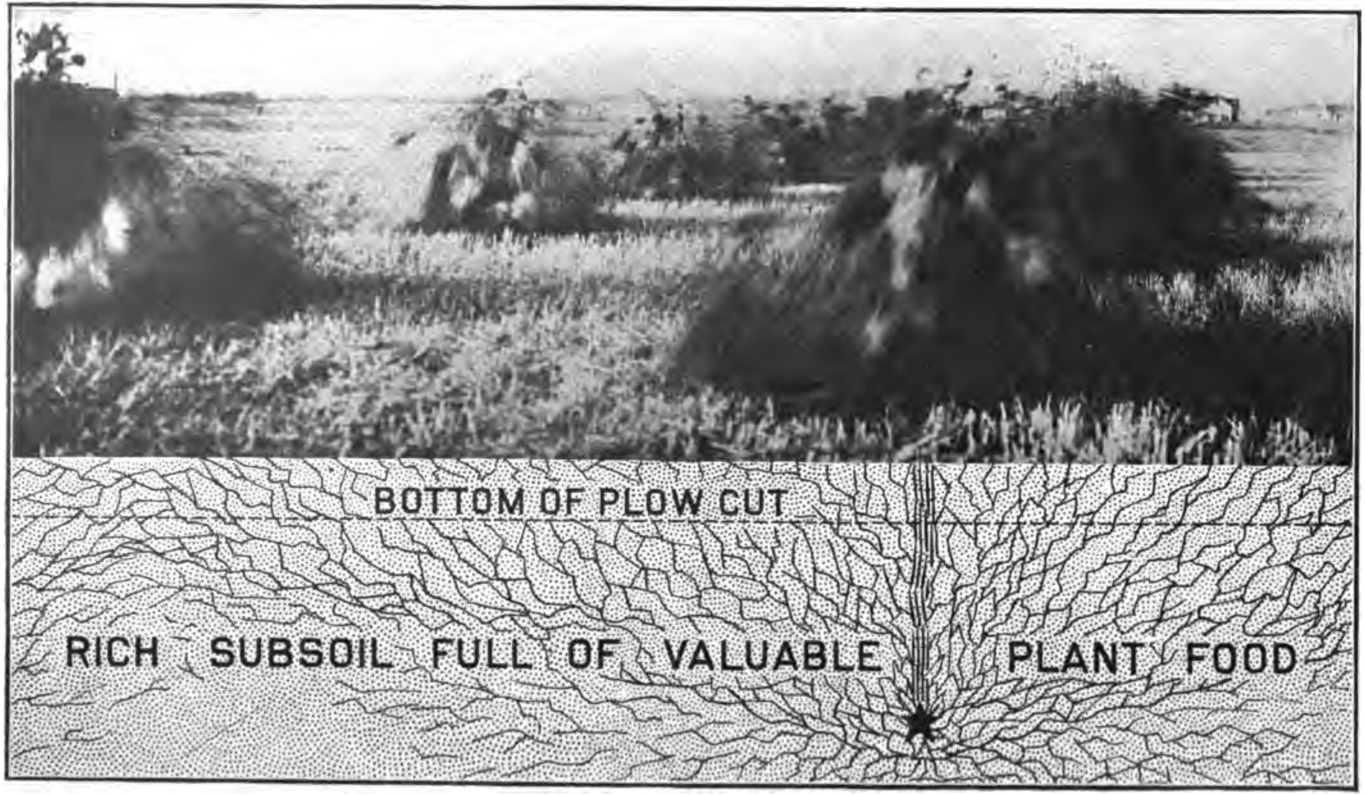
E. I. du Pont de Nemours Powder Co.
Established 1802
WILMINGTON, DEL.



DYNAMITING SUBSOIL—NOTE DEPTH OF PLOWED SOIL AND THE RICH SUBSOIL FULL OF VALUABLE PLANT FOOD

The Principles of Plant Growth

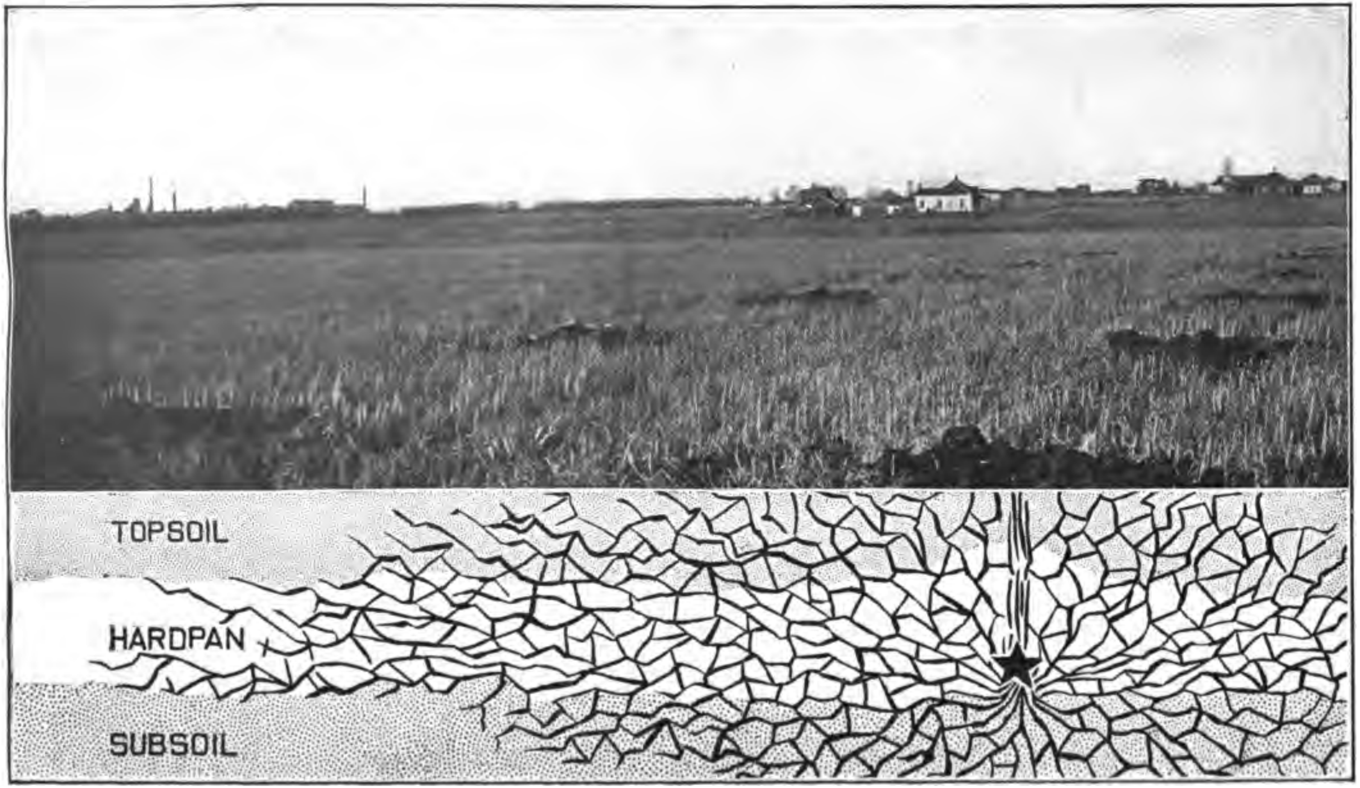
Scientific agriculturists have discovered that water is the most important element in all kinds of plant growth. Soil which is of the natural consistency to allow water to circulate freely through it and still retain or conserve it so that it is available at all times for growing plants, may be considered as ideal for agricultural purposes. Few soils possess this natural consistency. Other soils, which may be classified as good, average, or fair, must have artificial preparation in order to make them produce the results that may be expected from the rarely-found perfect natural soil.

Few persons understand the principle of plant growth. It is not necessary, as many suppose, that the root of a plant shall come in actual contact with all of the plant food elements of the soil needed for the sustenance of the plant or tree. Plant roots have the power to draw from the surrounding soil the neccessary elements of plant food, provided the soil is of such a character as to permit the passage of these elements through it. Water or moisture is the carrier of these plant food elements through the soil and into the plant roots. This will indicate the importance of a porous soil which will permit the free passage of water through it in order that plants growing upon the surface may be properly nurtured for rapid and healthy growth. It is because the action of an explosive on soil causes it to become thoroughly loosened and aerated that trees planted in blasted holes show so much stronger and healthier growth than trees planted under old conditions.

In order to give those who may not understand the subject an idea of the scientific principles of plant growth, we will quote Mr. W. J. Spillman, Agriculturist in charge of Farm Management Investigations, Bureau of Plant Industries, U. S. Department of Agriculture. He says in a recent bulletin:

"Plant food is dissolved in water. While a plant is growing, a constant stream of water flows up through it and evaporates at its leaves. For every pound of increase in dry matter made by the plant, from 300 to 500 pounds of water flow up through it.

"Plants in their growth make use of thirteen elements, nine of which they secure directly from the soil. These are called the mineral plant foods. They are phosphorus, potassium, calcium, magnesium, sodium, iron, silica, chlorin and sulphur. Soil consists mainly of small particles of rock. Nearly all kinds contain more or less of these mineral plant foods. Every year the soil water dissolves off a thin surface layer from each particle and plants appropriate this water, thus securing their mineral plant food. Hydrogen, another important element of plant food, is also secured from water.



BLASTED HARDPAN IN KANSAS—WITH SECTIONAL VIEW OF SOIL

" In order to produce a ton of hay on an acre of land, it is necessary that the growing grass pump up from that ground approximately 500 tons of water. In order to supply this enormous quantity of water, the soil must not only be in a condition to absorb and hold water well, but must be porous enough to permit water to flow freely through it.

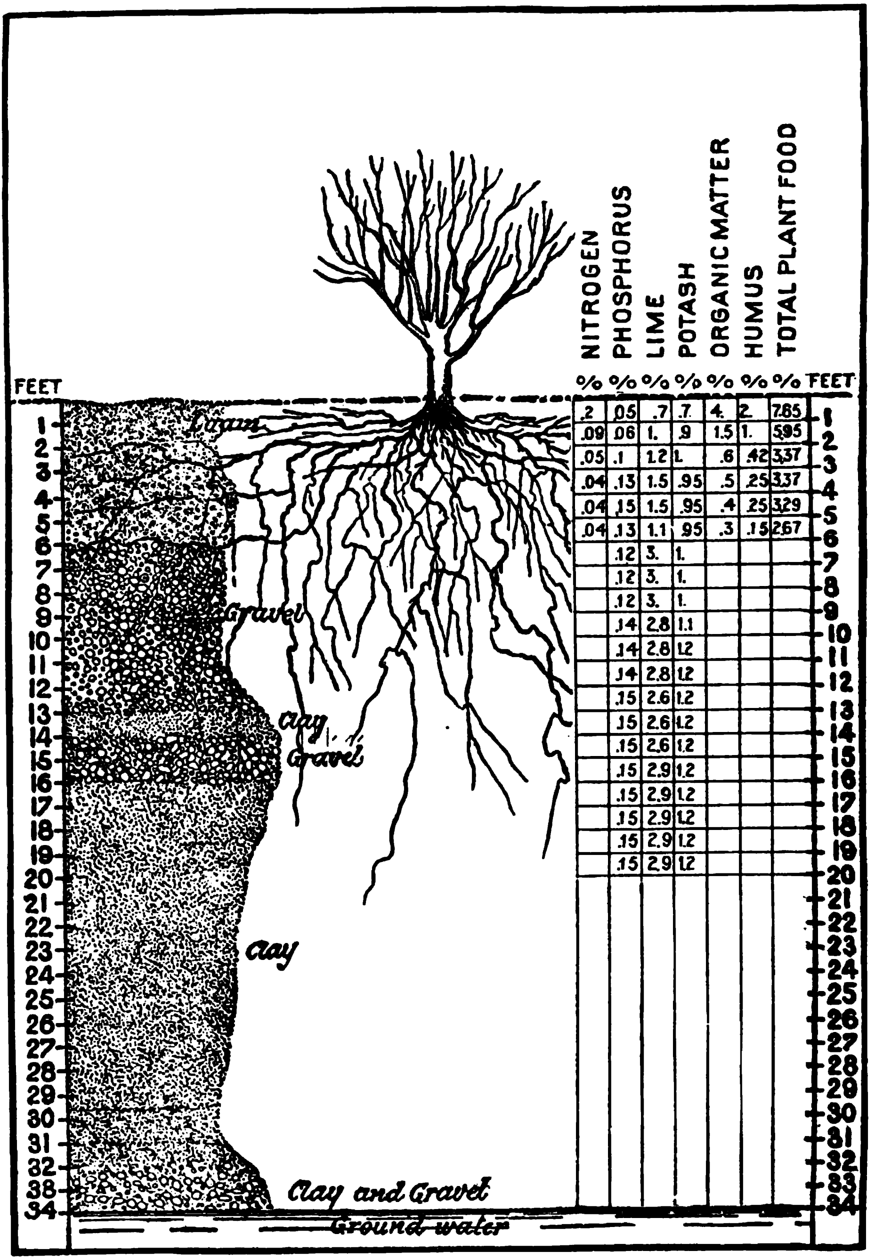
" In addition to acting as a water carrier for plant life, soil must permit a proper circulation of air through it. Nearly half of the volume of ordinary soils is occupied by air spaces. Soil which becomes so compact as to stop the air passages, is too wet for most crops and needs drainage, for plant roots must be supplied with air and the soil must be porous enough to permit of its free circulation. One of the most important objects of plowing is to loosen up the soil and mix fresh air with it."

The main object to be sought in tree planting, is to so prepare the ground that the growing tree can absorb as large a percentage of moisture as possible from the soil which it occupies. Loosening and aerating the soil accomplishes this purpose. A Cornell University authority advises that a tree planted in soil properly prepared, can absorb 60 per cent. of the moisture contained in it.

Orchardists and nurserymen who have had long experience in planting trees in holes prepared by dynamite blasts, have learned that compact subsoil is broken up by the blasts, which enables the land, thus made porous, to absorb plenty of water in rainy weather and store it up for the use of growing plants in dry weather. As Mr. Spillman says, this water in ascending to the plant roots, carries with it the many necessary soluble fertilizing elements.

It must not be assumed that dynamite blasting is beneficial only when the top soil is underlaid with hardpan. It is of the utmost importance to assist a tree, especially a young one, to send its roots out into its feeding bed as easily and rapidly as possible. The more porous and loose the soil, the more rapid will be the growth. Even in the loamy soils of the Northwest, generally admitted to be among the most perfect for fruit tree culture found in the United States, blasting has proven extremely beneficial in forwarding the growth of young fruit trees as is shown by photos of trees grown in Edgerogue Orchards, Grant's Pass, Oregon, which appear on page 8 of this booklet.

Few persons realize the depth of tree root expansion. In one of the " Farmers' Bulletins " issued by the United States Department of Agriculture, is shown a view of a cross section of orchard land which we reproduce on the following page. Note the scale on the sides, indicating that this tree has sent its roots downward 21 feet into the soil. This is natural growth. Under normal conditions a healthy tree will seek its food in this way; but suppose a layer of hardpan is encountered at a depth of 5 or 6 feet? The roots must then spread out laterally for 20 feet or more. The result of this unnatural sidewise growth is that each tree in the orchard is compelled to go over into the feed-



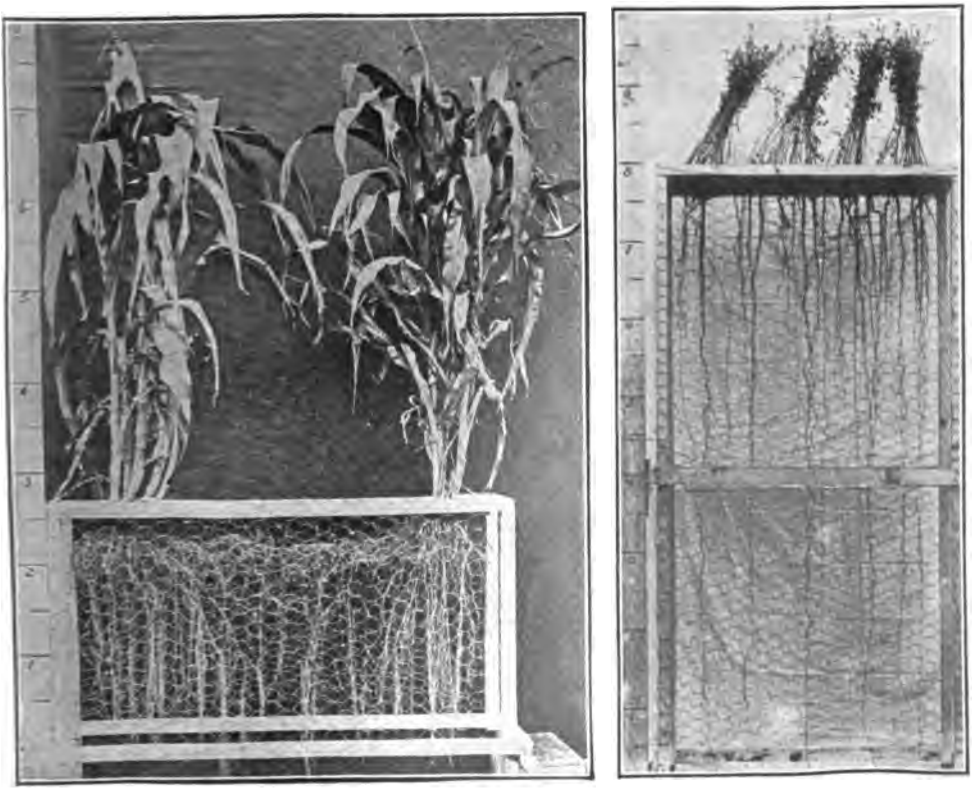
NITROGEN %	PHOSPHORUS %	LIME %	POTASH %	ORGANIC MATTER %	HUMUS %	TOTAL PLANT FOOD %	FEET
.2	.05	.7	.7	4.	2.	7.65	1
.09	.06	1.	.9	1.5	1.	5.95	2
.05	.1	1.2	1.	.6	.42	3.37	3
.04	.13	1.5	.95	.5	.25	3.37	4
.04	.15	1.5	.95	.4	.25	3.29	5
.04	.13	1.1	.95	.3	.15	2.67	6
	.12	3.	1.				7
	.12	3.	1.				8
	.12	3.	1.				9
	.14	2.8	1.1				10
	.14	2.8	1.2				11
	.14	2.8	1.2				12
	.15	2.6	1.2				13
	.15	2.6	1.2				14
	.15	2.6	1.2				15
	.15	2.9	1.2				16
	.15	2.9	1.2				17
	.15	2.9	1.2				18
	.15	2.9	1.2				19
	.15	2.9	1.2				20

FIGURE 4

Soil section showing downward growth of roots to 21 feet, and percentages of various plant foods at different depths. As the drawing and tables were obtained from different sources, the percentages do not indicate those in the soil in the drawing, but are composite percentages from analyses of different soils.

ing supply of its neighbor and consequently does not receive the necessary amount of plant food to properly nurture it and allow of its rapid growth. Its yield of fruit is also lessened by this forced encroaching of one tree on the feeding ground of its neighbor. Then too, a brief dry spell exhausts all the moisture from the thin feeding ground of such a tree, stopping its growth or killing it.

Dynamite blasting proves a simple and effective remedy for this condition. The blast breaks up the hardpan and permits the roots to take their natural downward course into the lower strata of the soil in which plenty of plant food elements are available. Under these conditions, one tree is not interfered with by another; each one receives the benefit of all of the soil allotted to it at the time the surface was measured and laid out at planting time.



SHOWING HOW CORN AND ALFALFA ROOTS GO DOWN INTO SUBSOIL

FIGURE 8
BING CHERRY TREE, TWO YEARS OLD
SET IN DYNAMITED HOLE

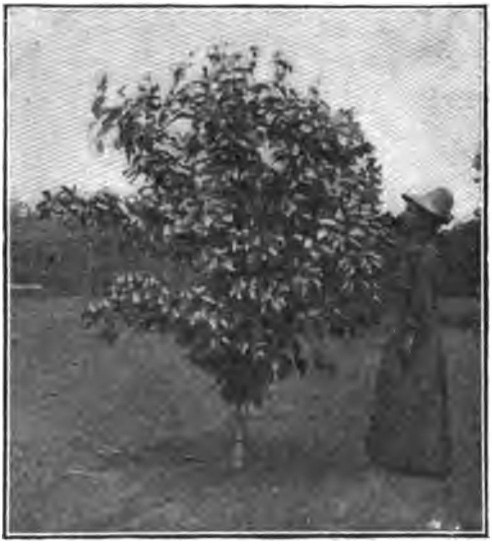
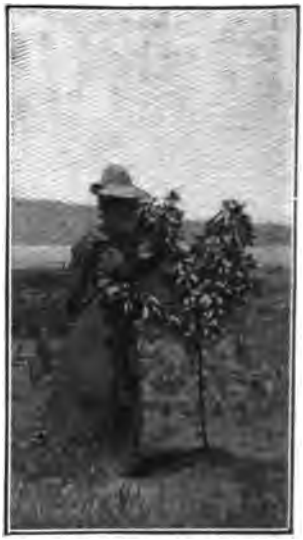
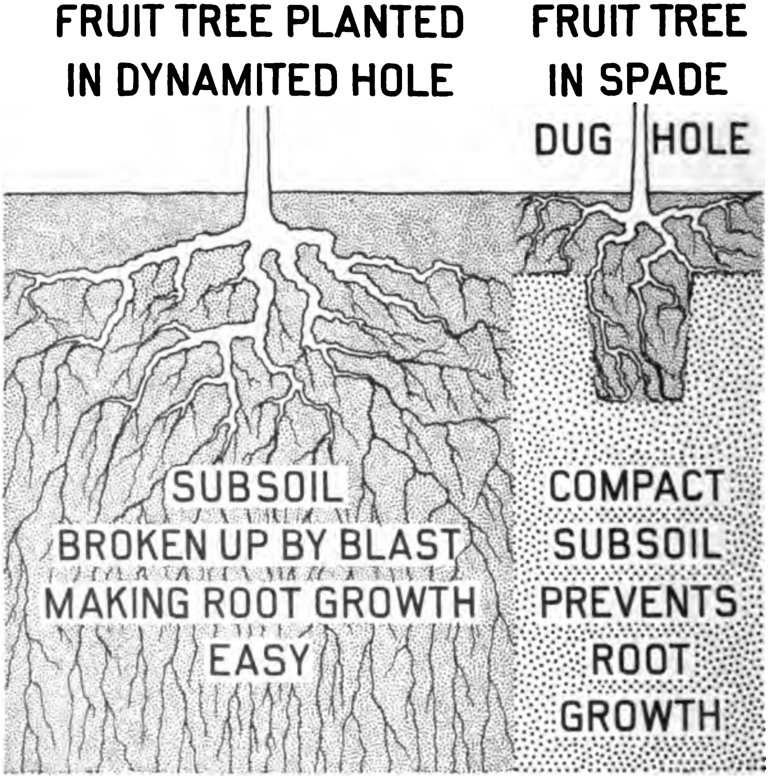


FIGURE 7
BING CHERRY TREE, TWO YEARS OLD
SET IN SPADED HOLE




FRUIT TREE PLANTED IN DYNAMITED HOLE
FRUIT TREE IN SPADE DUG HOLE
SUBSOIL BROKEN UP BY BLAST MAKING ROOT GROWTH EASY
COMPACT SUBSOIL PREVENTS ROOT GROWTH

Deep Plowing Increases All Crops

The value of dynamite in the orchard has been proved beyond question. (See our tree-planting booklet, sent free.)

Let us now consider its value in the production of the vegetables and grains that constitute our chief farm products.

Of course a tree is merely a plant or form of vegetation and the process of soil preparation which will benefit an apple tree will benefit a corn stalk, or a head of cabbage, or a tomato plant, or any other form of vegetation which draws its sustenance from the soil through its roots, and with the exception that different plants feed upon different plant foods, the principles of their growth and life are the same in all forms of vegetation.

But we are not obliged to go by theory or opinion. In the following pages we prove by actual photographs and incontrovertible testimony that deep plowing with dynamite increases the growth and fruition of corn, tomatoes, beans, grapes and watermelons, oats, alfalfa, flowers and cotton.

This is really just what we should expect. The giant redwood of California, the pine of the South, the elm of the North, are all vegetables of larger growth. And so right on down the scale of size and kind in the realm of plant life—corn, tomatoes, wheat, cotton, cabbages or radishes—all are vegetables whose homes are the soil, and which live on the soil and the water, air and fertilizing elements therein.

For generations and for centuries the top layer of our soil has been cultivated to a plow depth of 8 to 10 inches. The same soil has been turned over, year after year, and gradually robbed of its natural, original fertility. Now the almost universal condition of farm land throughout this country is that it will not grow good crops unless extensively fertilized, deeply plowed and the crops rotated carefully.

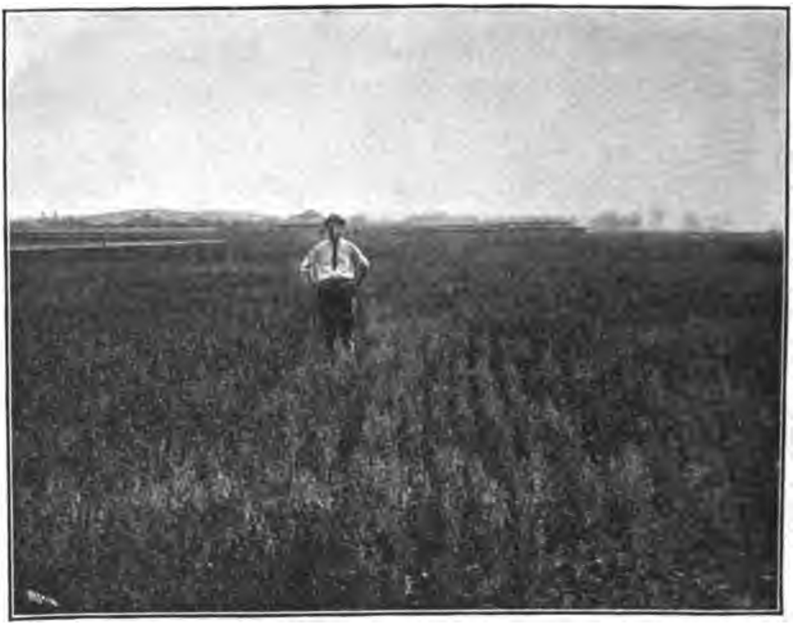
In spite of all these efforts to keep the top soil rich and productive, the average yield per acre of all standard crops is steadily decreasing.

Deep plowing is, in most cases, the remedy for soil deterioration. When done with a subsoil plow to a depth of 16 to 18 inches, there is a noticeable increase in yields. When done with dynamite to a depth of 5 to 6 feet there is a phenomenal increase in yields.

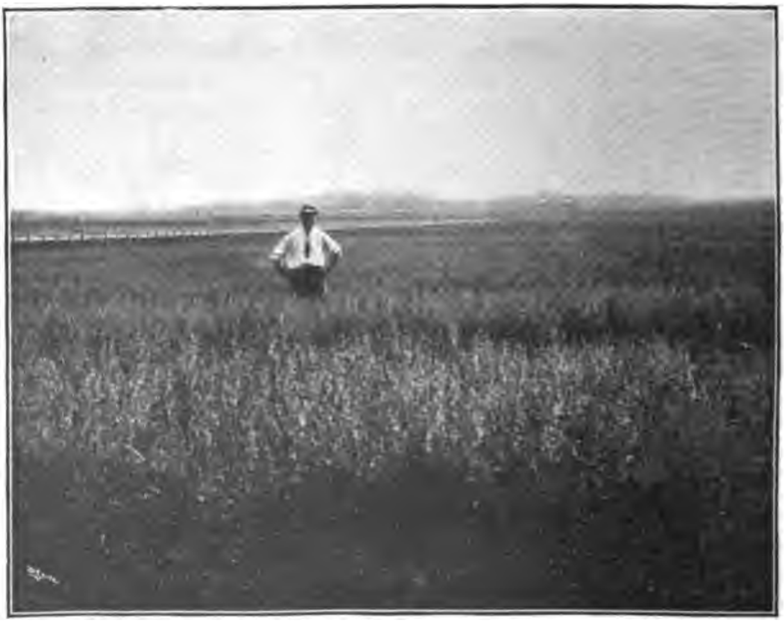
Let us now consider the evidence that proves the great value of deep plowing with dynamite for various crops.

A pioneer in subsoiling with dynamite was ex-Governor Crawford of Kansas. Below is a letter from him that tells of his experience.

"I am glad the good work of blasting the compact subsoil and hardpan is moving along in the east as well as in the west, whether it be for the planting of trees, grain or anything else that grows from the ground. If the subsoil is loosened so that the rainfall can penetrate the earth, the roots of grain, grasses,



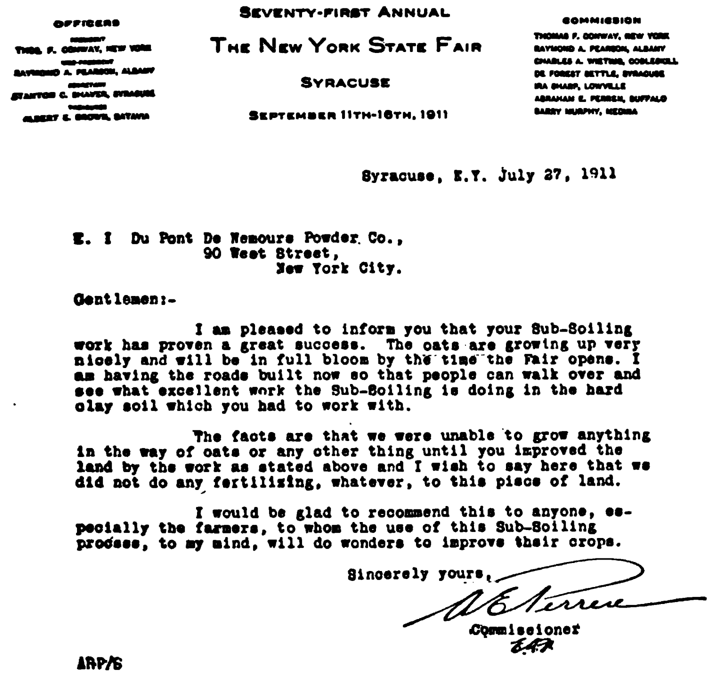
OATS GROWN ON N. Y. STATE FAIR GROUNDS AT SYRACUSE ON GROUND NOT PLOWED WITH DYNAMITE. NOTE THIN ROWS, SHORT STALKS AND POOR HEADS



OATS GROWN ALONGSIDE OF CROP IN UPPER PICTURE BUT ON GROUND DEEP-PLOWED WITH DYNAMITE. NOTE HEIGHT, VIGOROUS GROWTH AND WELL DEVELOPED HEADS trees, etc., will follow the water to their natural depth and draw their nourishment from five or six feet of soil instead of five or six inches of surface soil, as heretofore. Besides, the blasting creates sub-reservoirs in which to store the surplus rainfall which will supply the roots of the growing products with moisture when the dry season is on. Again, if the ground is loosened so the water can pass down into sub-reservoirs, there will be no standing water on the surface to damage the crops or keep the farmers back with their work. Such treatment, properly applied, will revolutionize the agricultural and horticultural industries throughout the country.

"The government is spending millions of money for irrigation purposes in isolated places, which, from the nature of things can only benefit a few people, while the blasting process will benefit all the farmers and fruit growers at comparatively a nominal expense. By this process most of the worn-out farms in New England and throughout the country can be re-claimed and made to produce good crops. All that is necessary is for the producers to grasp the idea and learn how to handle explosives."

Below we reproduce a letter from a New York State Fair Commissioner that speaks for itself. The photos of the crops on the undynamited and dynamited land, taken the same day, are reproduced on the opposite page.



OFFICERS
THOS. F. CONWAY, NEW YORK
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STANTON C. SHAVER, SYRACUSE
ALBERT E. BROWN, BATAVIA

SEVENTY-FIRST ANNUAL
THE NEW YORK STATE FAIR
SYRACUSE
SEPTEMBER 11TH-16TH, 1911

COMMISSION
THOMAS F. CONWAY, NEW YORK
RAYMOND A. PEARSON, ALBANY
CHARLES A. WIETING, COBLESKILL
DE FOREST SETTLE, SYRACUSE
IRA SHARP, LOWVILLE
ABRAHAM E. PERREN, BUFFALO
BARRY MURPHY, MEDINA

Syracuse, N.Y. July 27, 1911

E. I Du Pont De Nemours Powder Co.,
90 West Street,
New York City.

Gentlemen:-

I am pleased to inform you that your Sub-Soiling work has proven a great success. The oats are growing up very nicely and will be in full bloom by the time the Fair opens. I am having the roads built now so that people can walk over and see what excellent work the Sub-Soiling is doing in the hard clay soil which you had to work with.

The facts are that we were unable to grow anything in the way of oats or any other thing until you improved the land by the work as stated above and I wish to say here that we did not do any fertilizing, whatever, to this piece of land.

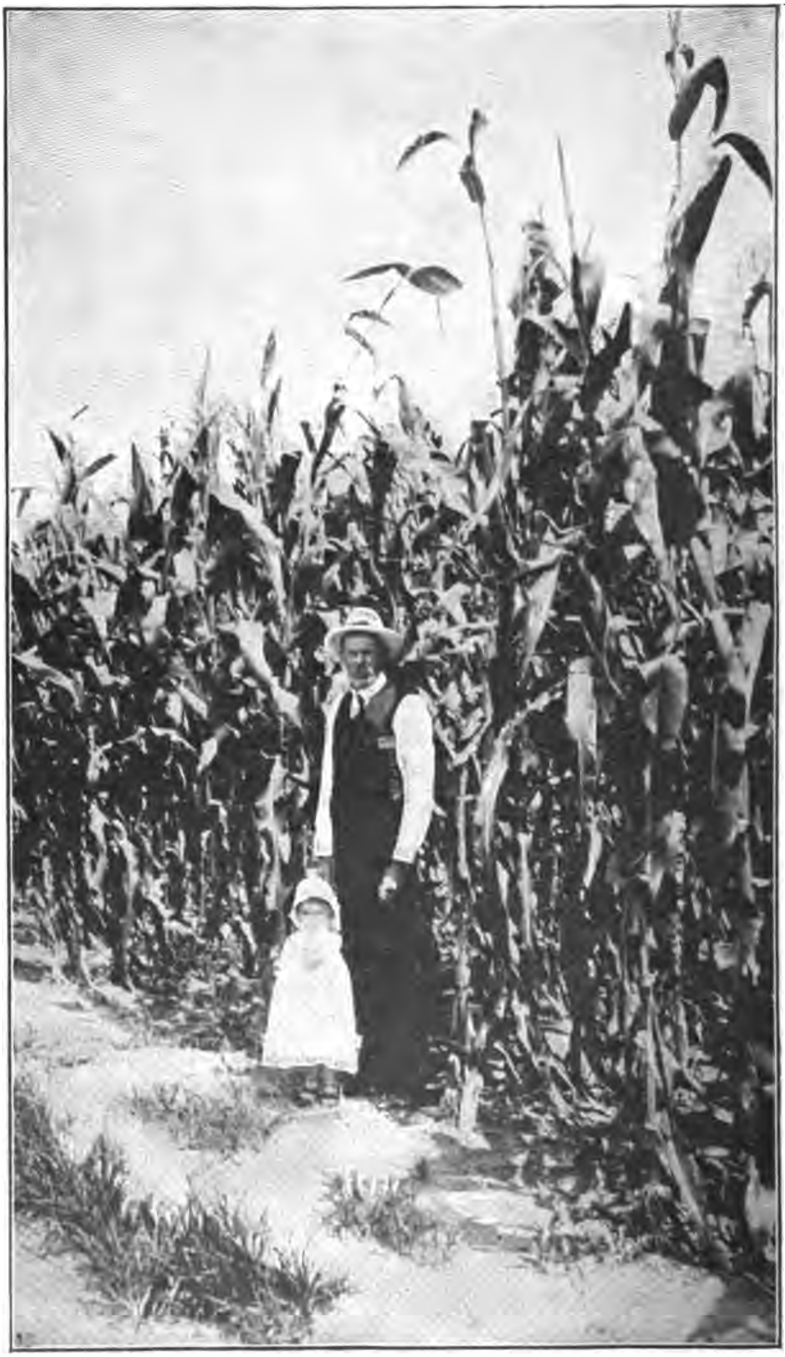
I would be glad to recommend this to anyone, especially the farmers, to whom the use of this Sub-Soiling process, to my mind, will do wonders to improve their crops.

Sincerely yours,

A E Perren

Commissioner

ARP/S



CORN GROWN ON BLASTED GROUND AT SPARTANBURG, S. C.

Deep Plowing Makes Big Corn Yields

One of the first experimenters with dynamite for deep plowing was J. H. Caldwell of Spartanburg, S. C. He subsoiled a portion of his corn-field with dynamite and increased the yield one-third over that of the portions not subsoiled. A committee of the Chamber of Commerce of Spartanburg inspected this corn and certified to the accuracy of the figures. An illustration of this corn is shown on the opposite page.

Good Crop of Buckwheat Raised on Ground Proven Worthless

Low Cost — Big Crops

Derrick City, Penn., August 26, 1911.

E. I. du Pont de Nemours Powder Co., Wilmington, Del.

Gentlemen: On my farm was a four acre field upon which no crops had been grown. One acre of this was dynamited to break up the subsoil and then sown to buckwheat. The three acres left were not dynamited or cultivated for any crop. The crop is growing finely and I expect to harvest buckwheat of superior quality, a large yield and worth the highest market price because of the improvement of soil on which this buckwheat is now growing. I value this acre now at fifty dollars, which was formerly worthless, and counting cost of explosives, which I found for this acre to be four dollars, I feel that my test is good proof that dynamiting subsoil pays.

This Fall I am planning to dynamite the subsoil on the three acres that are now unproductive. I am sure that next year will see good crops on the whole four acres and that my farm will be worth more to me by increased acreage and better crops, and my success with dynamite will be the means of using it in a larger way. I want to add that my stump-pulling machine is now "out of a job," for the dynamite used for blowing 60 pine stumps showed me the quickest, easiest, surest and best way to clear stumps from my land.

Yours truly, W. C. MAXWELL.

HARVESTING ALFALFA FOR THE CHURCH ON A DYNAMITED FIELD WHERE FORMERLY LITTLE OR NOTHING GREW

COTTON GROWING ON LAND WITH REGULAR CULTIVATION. NORMAL YIELD, 400 LBS. PER ACRE. OCONEE COUNTY POOR FARM, WALHALLA, S. C.

COTTON GROWING ON SAME FARM IN ADJOINING PLOT BUT SUBSOILED WITH DYNAMITE. 1911 YIELD ESTIMATED AT 800 TO 1000 LBS.

Dynamiting Subsoil of Cotton Field Doubles Crop

Walhalla, S. C., August 5, 1911.

Gentlemen: I wish to tell you about my experience using dynamite on part of a field of cotton. The size of the plot was 30 ft. x 90 ft. The soil of the whole cotton field was given the usual cultivation before sowing the seed. I am very greatly pleased to say that the small plot of dynamited soil has shown a better crop,—in fact the yield from this dynamited soil will be, in my judgment, between 800 and 1000 lbs. per acre, or more than *twice as many pounds of seed cotton* as will be picked from the same size of plot adjoining the dynamited plot.

The success of this tested plot is so assured that I am going to use dynamite on 30 to 60 acres of land now growing good crops. I feel that dynamiting the subsoil of these acres is going to result in greater crops. I figure that I can do this at a cost of four to five dollars an acre. In dry soil I use a quarter of a dynamite cartridge in holes placed fifteen feet from each other. This takes 49 sticks or cartridges of dynamite to the acre, approximately 25 pounds. My test of dynamiting the cotton plot was the means of showing me how I can make my acres grow bigger, better and more valuable crops at small cost and increase the fertility of my farm.

W. R. COBB, Steward Oconee County Poor Farm.

Another Big Yield of Cotton from Dynamited Ground

Eatonton, Ga., September 21, 1911.

Regarding the dynamited field of cotton of J. G. Spivey:

Mr. Spivey told us last week that he picked 2¼ bales of cotton off of the 1¾ acres of dynamited land the first picking and says he will get 5 bales from this piece of land when he finishes.

This cotton has been the talk of the country, and a great number of people have visited this particular spot. We are sure it is going to do your Company a great deal of good in the sale of dynamite.

One of the pictures show dynamited cotton on one side of the road and cotton where dynamite was not used on the other. It does not do full justice, as the cotton dynamited is about 5 or 6 times as good, both in size and fruitage as that which was not dynamited. No one can well conceive the difference unless they were on the ground like the writer was some thirty days ago.

HEARN & GREEN HDWE. CO.

SHOWING CORN GROWING ON SUBSOILED GROUND AT ARROW POINT

MR. FOWLER STANDING IN CORN ON SUBSOILED GROUND

Record Crop on Dynamited Ground

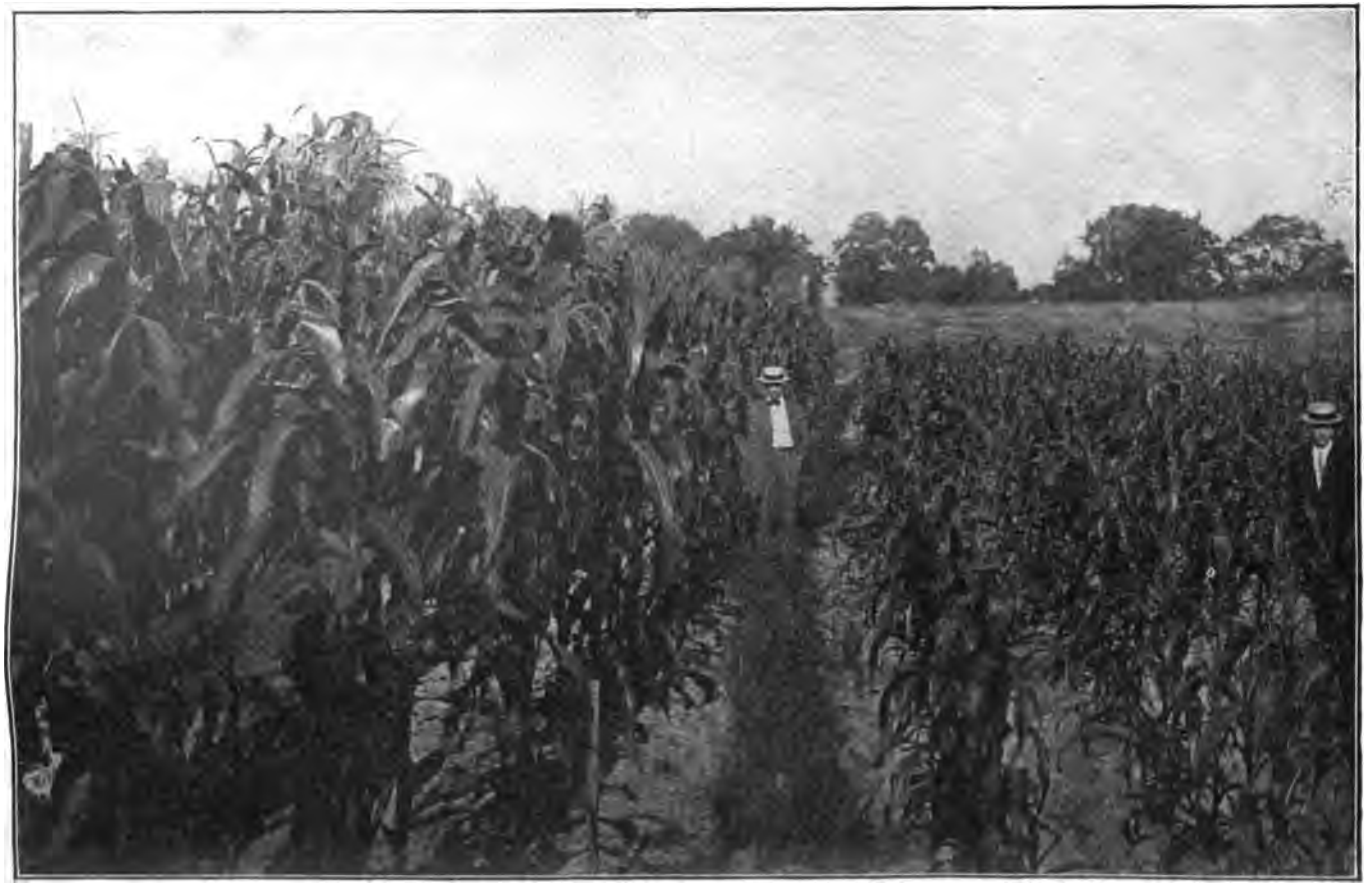
From OHIO STATE JOURNAL, Columbus, Ohio, August 10, 1911

Among the visitors to Columbus yesterday was J. S. Fowler of Anderson, S. C. He is one of the original dynamite farmers of the South, the new method of farming which is making the South proof against the droughts which have so often blasted the hopes of its farmers.

He brought with him pictures showing corn fields planted by the dynamite method, to prove that the stories he told of the corn crops were not fabrications, absurd as they might sound to the ears of farmers in what is supposed to be one of the great corn-raising sections of the country. The land in the western part of South Carolina is good, and Mr. Fowler said that under the old method he had raised 100 bushels of corn to the acre on his plantation, which consists of 2000 acres, but this yield has more than doubled under the new method.

This year he prepared four acres with dynamite. Half a stick of 40 per cent. dynamite was used to each 15 feet square, the dynamite being placed in holes punched in the ground and then fired. It cost $18 an acre for the dynamiting. This stirred up the ground from three to four feet deep. It was plowed and harrowed in the usual manner and the corn drilled. Just before he came to Columbus, the time when the pictures were taken, officials from the government agricultural experiment station visited the field and estimated that the corn would yield 260 bushels to the acre. Mr. Fowler says that he does not believe that it will go that high, but states that he expects over 800 bushels from the four acres. Some of the stalks of corn have from three to five ears and all are large. The corn is about 15 feet high and very uniform. Next year he expects largely to increase his dynamite acreage. One dynamiting does for years, it is said, and the corn requires but little rain, as what does fall is held in the ground. Mr. Fowler says that the cotton crop in the South this year will be a record-breaker, in spite of the reports of dry weather. "We have learned many lessons," he said. "We are plowing deep for our cotton and the dry weather does not damage us as it once did. This year streams are dry, the cotton mills have closed because of failure of water power, but there has not been any damage done to the crops. Our new methods of farming have made us practically independent of the midsummer droughts, and the cotton speculators who are counting on a short crop because of dry weather are going to be badly stung.

"Cotton has never looked better than this year in all the Southern States in which I have been, and the weather has never been so dry. Under old methods of planting the crop would have been almost a total failure. But now it does not show any damage at all. The Southern farmer is taking up new methods, and already he is beating the big yields once reported from Northern farms. This fall hundreds of old farms will be dynamited and next year they will raise immense crops of corn and cotton. It costs money, but we are getting it back and have never been so prosperous."



CORN GROWING ON DYNAMITED SOIL CORN GROWING ON SOIL NOT DYNAMITED

Result of Experiment with Du Pont Red Cross Dynamite on Clarksville, Tennessee, Experiment Farm

Remarkable Results Achieved on Barren Ground by Dynamiting Subsoil on Farm of Agricultural Experimental Station, Clarksville, Tenn.

(See cut on opposite page)

Under date of August 16, 1911, Mr. S. L. Smith, Superintendent of City Schools, Clarksville, Tenn., writes as follows regarding "Subsoiling with Dynamite":

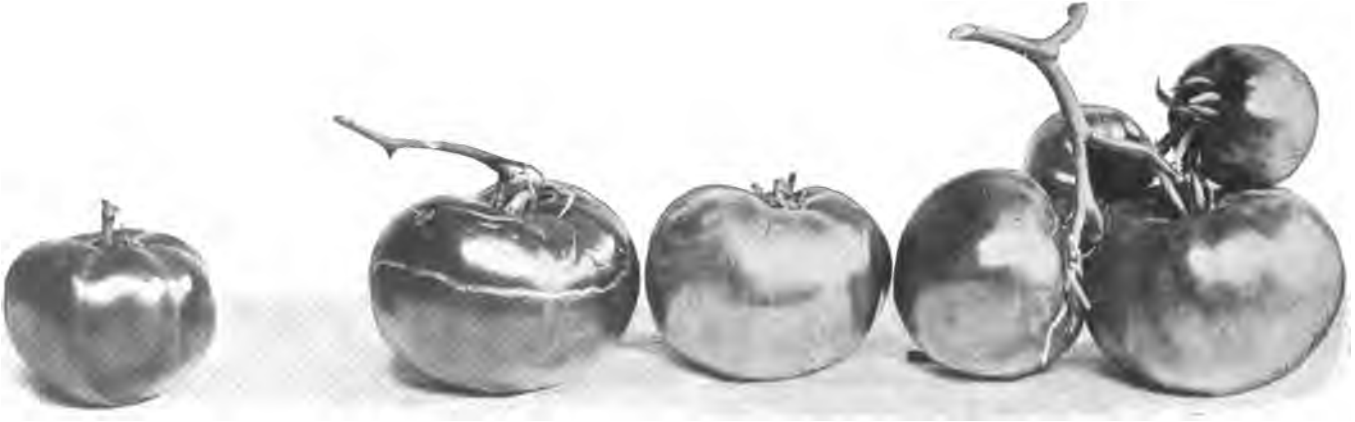
"During December, 1910, I subsoiled one acre of ground on the Experiment Farm here which is run under the direction of the Agricultural Department of the joint High Schools, which ground before that time had produced nothing for several years. It was 'worn-out' land. This subsoiling cost about $12.00 per acre, but as compared with the excellent results obtained, I consider that it has paid us well.

"The corn shown on the left of the photograph which I sent you is on the dynamited ground. That on the right of the same photograph represents corn planted and cultivated in the ordinary way without any scientific methods—no subsoiling. No fertilizer used on either the subsoiled or unsubsoiled ground, but well cultivated. Otherwise, the land not subsoiled was considered better than that subsoiled.

"Both acres were planted the same day and the subsoiled land will yield possibly three times as much as that not subsoiled. In fact, it is the best corn in the county, and all the farmers of the county who have seen it realize there is something in scientific farming. We selected the poorest land we could find, and it is my intention to subsoil more ground this Fall."

F. G. Moughon, of Walton County, Georgia, reports that he has been raising crops of watermelons, weighing 50 to 60 pounds each, on land blasted by exploding charges of about 3 ounces of dynamite in holes 2½ to 3 feet deep, spaced 8 to 10 feet apart.

CROP OF WATERMELONS GROWN ON LAND PLOWED WITH DYNAMITE. WALTON COUNTY, GA.



GROWN ON SOIL NOT DYNAMITED
AVERAGE WEIGHT 6 OZS.

THESE TOMATOES GROWN ON DYNAMITED SOIL. AVERAGE WEIGHT 10 OZS.
BOTH FROM SAME SEED AND IN SAME LOCALITY

DYNAMITED SUBSOIL OF A GARDEN PLOT RESPONSIBLE FOR THE LARGE, LUSCIOUS TOMATOES SHOWN AT RIGHT OF PICTURE

Haddonfield, N. J., September 5, 1911.

E. I. du Pont de Nemours Powder Co., Wilmington, Del.

Gentlemen:—Referring to the photograph of tomatoes sent to you. These were grown on a plot about 10 x 20 feet, subsoiled with a third of a cartridge of Red Cross Extra Dynamite in each of four holes. The charge was 3½ feet below the surface and was fired by a blasting machine. No. 6 Victor Electric Fuzes were used. This plot has a top layer of soil about 2 inches deep and of red gravel composition.

The tomatoes in the picture were photographed July 29, 1911. August 15, tomatoes were ripe; about the 20th I picked some weighing from 8 to 12 ounces. Today, September 5, 1911, the vines are still growing with various sizes of green tomatoes. There are some blossoms now and I will have tomatoes until frost. (See page 28).

A friend had some tomato plants same as mine, all the seed from the same tomato. He has a good garden, but his tomato vines produced much smaller fruit, clearly proving the advantages of dynamiting subsoil for crops in garden or field.

Yours very truly,

L. Z. LAWRENCE.

Plowing With Dynamite to Conserve Moisture

ARTHUR E. COLE, Prop., High Point Farm and Nursery, Chamblee, Ga.

Over a large portion of our country is a hardpan, shale or tight clay near the surface. It is a menace to the productiveness of trees and all vegetables which root deeply. The scientific principle involved is the inability of such a subsoil to absorb, retain and give back to growing crops the essential moisture. On such land, the water soaking through a thin top soil fails to penetrate and finds a second drainage on this subsurface, draining off in "Wet Weather Springs" or standing in surface suspense as "Bogs." Land in this physical condition fails of an agricultural dividend. Put in proper physical condition this same land becomes highly profitable. The way to proceed is by using dynamite. Probably no process of plowing known to agriculture can produce the good results in breaking up a tight subsoil that this blasting does with Du Pont Dynamite.

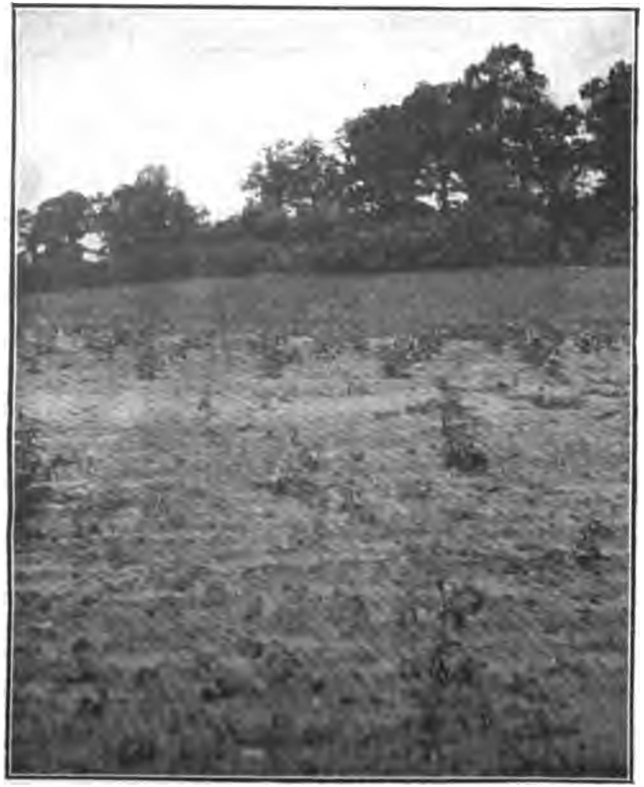
Planters of clover and alfalfa know this by experiment. Orchardists have come to accept it as final. Strawberries and all crops requiring a great amount of moisture respond to its use in a way almost unbelievable. Short lived crops like tomatoes and cucumbers will continue to bear through the long season where the hills are blasted with cartridges of dynamite. Figs produce a crop the first year after being set where dynamited. The writer can see this from his back door as he writes. This new-found process is the foundation of a new era in agriculture and horticulture. It is the horticulture application that this article aims to emphasize.

At the present time many thousands of trees are being set in young orchards all over the United States. Such a boom in apple and pecan planting was never before known. It is a logical answer to an unsupplied demand. The question is, will these orchards endure,—will they pay? The answer rests largely with the mode of setting.

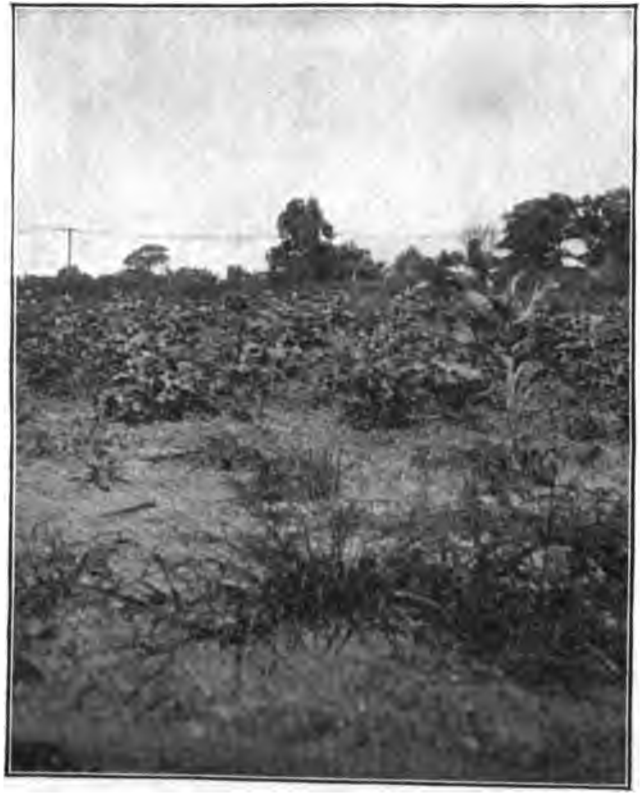
In orchard setting, the use of dynamite is advised in practically all soils. The pecan naturally flourishes on the deep, moist, alluvial soil of river and creek bottoms. Nature has put it where it will not suffer from drought in the long, hot, dry summer and autumn through which it must hold and mature its late fruit. We can move it to our grove or back yard and succeed with it by conserving the moisture by dynamiting the ground.

The method of dynamiting follows under discussion of apples.

Watermelons and peaches should be dynamited because they require great moisture, being fruits composed largely of water, but of all fruits demanding an unfailing and continuous supply of moisture the apple and pecan lead. Therefore, it is imperative that we dynamite as an artificial means of conserving the moisture. Unlike all other fruit, the apple grows on the end of a twig of new



LIMA BEANS GROWING ON SOIL NOT DYNAMITED



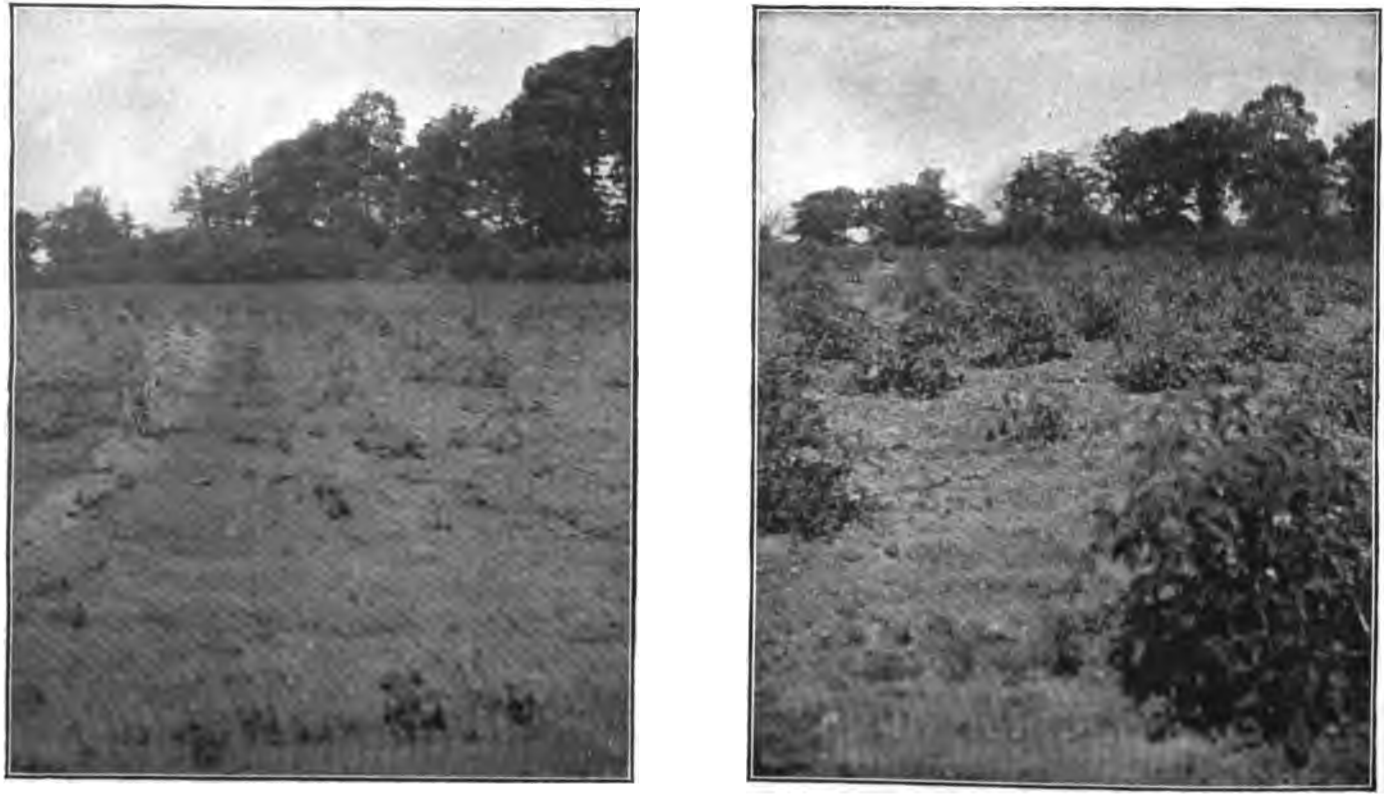
LIMA BEANS GROWING ON DYNAMITED SOIL

VIEWS FROM GARDEN PLOT OF L. D. THOMAS, BALTIMORE, MD.

The Plants in the View at the Left Produced no Beans. The Subsoiled Plants Yielded a Good Crop in Spite of the Dry Weather wood, a twig which bears no more. The apple being a biennial, sets its fruit bud for next year during July and August of this year. So we see this hard condition imposed: a winter apple must make its new growth of wood, hold its foliage, mature its present crop of fruit, and, if it is to produce again next year, the little tender twig bearing an apple must mature a new fruit spur or twig alongside of it to bring forth a healthy fruit bud next year. And all this during a long, hot summer or autumn. The demand for moisture is enormous.

What if the tree is shallow set? What if the roots trail along close to the dry surface? What if the tree is on a dry ridge or hill-side baked by the summer sun? What if on thin land, starved for both fertility and moisture? The answer may be total failure or partial failure and short lived trees, or a partial crop, or a crop only every other year, or a large per cent. of drops, or defoliated trees. READER! Observe and mark well. Your orchard dividend and its future success is in balance when you *set* your orchard. Remember you can never set it over the second time. No amount of regrets can retrieve a mistake made in the setting. You will spend much money bringing your orchard to a high standard by the allotted time for it to begin to bear, but no amount of money expended in after years can correct a mistake at planting time. You may have in mind plowing out a deep furrow for your row, but remember that that furrow can never be plowed again, and the root system will be influenced to confine its growth to the small amount of pulverized soil. Holes may be dug, broad and deep, but like a large plant in a small pot, the hard walls of the hole when filled with roots will cramp or turn back or callous. In either of these methods the orchard dividend will be found wanting.

The new and successful mode of land preparation for all fruit or ornamental trees and for many field or garden crops, especially in tight, dry soils, is by blasting with ½ cartridge of Red Cross Extra Dynamite at intervals of 15 to 20 feet. If in a large orchard or field, a blasting machine and electric fuzes may be used to explode the dynamite. If only a few trees are to be set, the dynamite should be exploded with fuse and blasting caps. Let the depth of the holes for setting your cartridge be governed by the state of the soil. Make a hole with auger, sharpened wood dibber, or crowbar well down into the subsoil. Tamp well with moist clay. For the best results, throw out a bushel or more of the clay that has been broken by the shot and fill with some organic matter that will slowly decompose as the years go by, mixing and cutting it well with a sharp shovel or spade. Leaf mold, woods top soil, fence corner settlings, old bones, scrapings from under an old house or outhouse or any such matter is good. Now the tap root can go down and out in an area broken and pulverized for many feet on all sides. The tree will make a rapid and healthy growth and come to bearing earlier and live many years longer. It will produce fruit annually, more fruit, larger fruit and fruit of better color



TOMATOES GROWING ON SOIL NOT DYNAMITED

TOMATOES GROWING ON DYNAMITED SOIL

VIEWS OF GARDEN PLOT OF L. D. THOMAS, BALTIMORE, MD.

Those in Left View Did Not Bloom, but Dried Up. Those in Right View Produced Fine Tomatoes because of the conserved moisture. It will resist drought. The much talked of "insect resisting tree" is not a tree immune from insects, but a tree healthy and vigorous enough to overcome their baneful attack.

The writer set an apple orchard last winter using Red Cross Extra Dynamite, in an area where woolly aphis is known to abound; but not a single evidence of their presence has been noted. This is a reverse of every instance of a young orchard in that section, set in the old way.

The winter, spring and summer just past is one of the dryest on record for Georgia. Many trees, in fact a large per cent. of trees, set by the ordinary method have died. But in three orchards set by the writer with dynamite, 100 per cent. are living and doing well. As a neighboring nurseryman expressed it, "These trees didn't know it had not rained."

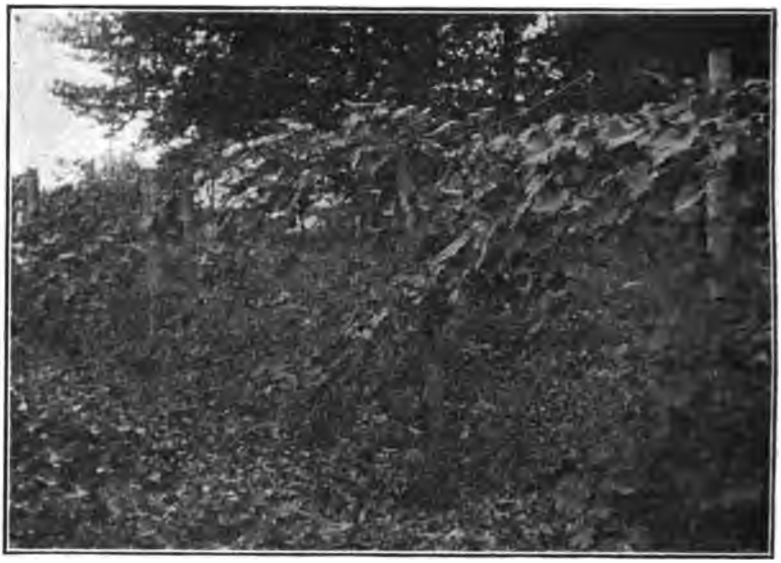
It is to be hoped that in tree setting, we have learned "That a stick in time saves nine."

Big Yield of Beans and Tomatoes

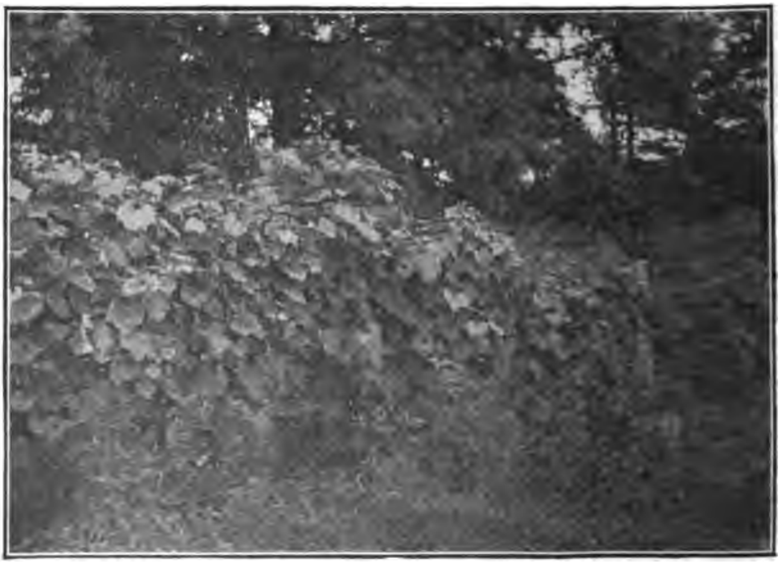
Baltimore, Md., September 26, 1911.

Today I examined the lima beans, and tomato vines on ground subsoiled, and not subsoiled. I found the lima bean vines on subsoiled ground growing nicely, and yielding 45 to 50 pods of most excellent beans to the hill, while on the ground not subsoiled the vines are in poor condition, and the hills only yielding at best not more than 9 pods to the hill, and in addition to this the vines are not in a good, healthy condition, and many of them will not yield any beans at all. The beans on subsoiled ground were planted at the same time as the beans on the ground not subsoiled and are at least four weeks in advance of the latter and are being marketed. The tomato vines on the subsoiled ground are yielding fully a half peck of tomatoes to the vine, while the vines on the ground not subsoiled are not yielding more than half a dozen tomatoes to the vine. Many of the tomato vines on the ground not subsoiled are dead and many others in very poor condition. Any one going over the ground will be immediateiy convinced of the great advantages of subsoiling with dynamite by noting the increased yield of crops over those obtained from ground not subsoiled. Every one who has visited the farm and witnessed the differences in the crops on the subsoiled and not subsoiled ground is loud in praise of the system of subsoiling with dynamite and will follow it this Winter and next Spring.

J. M. HANDSCHUH.



GRAPEVINES 20 FEET AWAY ON SAME ROW, WHICH WERE NOT DYNAMITED



PORTION OF ROW OF GRAPEVINES THAT HAD BEEN DYNAMITED THE PREVIOUS FALL

Blasting Saves Dying Grape Vines

Wilmington, Del., June 3, 1911.

On my farm near here I have quite a number of grape vines and a year ago I noticed at the time the leaves should have all been out that the vines appeared to be dead. The buds appeared to be blighted in some way. However, late in the season the leaves finally came out but there was no grapes on the vines. Last fall I had a demonstrator on the place doing some subsoil blasting and I had him blast between the rows of grape vines about every 10 feet or 12 feet along about ⅔ of the rows, the balance was left unblasted to see whether there would be any difference between the blasted and unblasted. This spring on the vines on the ground that was blasted the leaves came out early and grapes formed in abundance while the portion that was not blasted was exactly the same as a year ago. It would look as though the blasting had conserved the moisture during the winter and made the vines more vigorous and better able to overcome the blighting conditions than the portion not blasted.

W. C. MATTHEWS.

A Safeguard Against Drouth and Loss of Crops

Converse, S. C., August 3, 1911.

About four years ago, I blasted some good sized stumps out of my garden and consequently the ground around them was thoroughly shaken up to a depth of about four feet, and now, while on account of dry weather the stuff on the rest of the garden is practically a failure, the stuff on the blasted ground is fresh and green and growing very nicely.

I have concluded to fix more of it that way as I think it the best way to prepare land both for farming and gardening. I shall use and advocate the use of explosives wherever practicable, and I shall appreciate any literature you may get out from time to time on the use of explosives. J. E. KIRBY.

Dynamite for Drouth

[*From AGRICULTURAL EPITOMIST*]

While in Augusta County, Virginia, I visited the famous Rose Cliff Fruit Farm. This orchard is being worked with dynamite, to produce a subsoil, and the effects are beyond my power of explanation.

James Craig, President of the Company, says he will have 10 per cent. more fruit this year than last. He marketed last season 8,000 to 9,000 barrels. This year he kept 15 men in his orchard nearly a month thinning apples, and says his stock will be even finer than the past season.

Mr. Craig attributes this to the work of dynamite, which produces the subsoil which gives the trees nourishment even in the face of the everlasting dry spell. Mr. Craig tells me that he has some trees 55 years old,—from that down to some set out the past winter.

The orchard which he worked with dynamite is well worth any man's time to see.

Note: Mr. Craig used Du Pont Red Cross Dynamite.

TOMATOES GROWING ON SUBSOILED GROUND. SEE LETTER OF L. Z. LAWRENCE, PAGE 20

CORN GROWING ON DYNAMITED SOIL. CLEMSON COLLEGE EXPERIMENT STATION CLEMSON COLLEGE, S. C.

SUBSOIL BLASTING BY ELECTRICITY. GEO. KERR'S FARM, NEWARK, DEL.

APPROXIMATE COST OF SUBSOILING

Table showing number of holes and approximate amount of RED CROSS 25% EXTRA DYNAMITE and BLASTING SUPPLIES required per acre when breaking subsoil, blasting holes for tree planting or blasting midway between old trees to rejuvenate them, with holes spaced at various distances on the square system, and one-half of a 1¼" x 8" cartridge of RED CROSS 25% EXTRA DYNAMITE in each hole.

SPACING	Number of holes per acre	Lbs. Red Cross 25% Extra Dynamite	Number of No. 6 (red label) blasting caps per acre	Number of feet of fuse per acre for each foot in depth of hole	†Approx. cost per acre of materials for dynamiting 3 feet below surface
15' x 15'	194	50	194	*194	$16.00
18' x 18'	134	33½	134	134	11.00
20' x 20'	109	27½	109	109	9.00
25' x 25'	70	17½	70	70	6.00

*If holes are 3 feet deep, multiply the numbers shown in this column by 3; if 4 feet deep, multiply by 4, and so on, to arrive at the number of feet of fuse required per acre.

†This approximate cost of subsoiling per acre is based on the average price per pound of Red Cross 25% Extra Dynamite, 3 feet of Crescent Fuse and one No. 6 (red label) Blasting Cap per hole.

The Best Time for Subsoiling

Since one of the chief objects of subsoiling with dynamite is to create a water reservoir in the subsoil, it follows that the best time to subsoil is immediately after harvest and before extremely cold weather sets in. The Fall and Spring rains and the melting snows of Winter will then be absorbed by the porous soil and stored for the use of the plant during the hot, dry Summer.

The next best time is early in the Spring, as soon as the frost gets out of the ground. If the soil is very light and open it is best to blast it when it is wet, but in all compact or clay soils or hardpan the blasting is more effective if done when the ground is comparatively dry because it is then less tenacious than when wet and the force of the blast naturally shatters and breaks up a larger area.

It is not advisable to subsoil a cropped field during the hot season, as the roots of the growing crops, having only a shallow growth, would not reach the newly made water reservoir during that season, and since what little rain falls would sink to the lower level, the shallow rooted crop would probably die.

Subsoiling may be done at any time on land not cropped, to prepare it for a crop the next season.

Why We Recommend Red Cross Dynamite For Farm-work

Red Cross Dynamite is better suited for most of the blasting necessary about the farm, than any other explosive. Our many years of experience in the manufacture and use of explosives, has taught us that if an explosive is to do its work at the lowest possible cost and produce the best results, it must be made with qualities especially suited to the work in which it is to be used. Red Cross Dynamite is particularly strong in those qualities necessary in agricultural blasting.

Red Cross Dynamite is safer to handle and use about the farm than other dynamite which would do the work properly. A large majority of the accidents which happen when dynamite is used, occur in thawing it. Most dynamite freezes at a temperature ranging between 45° and 50° F., but Red Cross Dynamite can be depended on to keep soft and in good condition in any temperature that will not freeze water. When Red Cross Dynamite is frozen, it can be thawed simply by burying the case containing the dynamite in a manure pile until the cartridges become soft.

When dynamite is frozen or even chilled, it cannot be properly exploded, and consequently does poor work. Most dynamite, except Red Cross Dynamite, will chill and lose value in a very few minutes in cold weather. Even when loaded in cold earth or rock it will chill in a very few minutes. This loss does not happen with Red Cross Dynamite because it will remain in perfect vorking condition for some time, even in freezing weather, and it does not lose any power at all after it has been loaded in bore holes below the frost line.

Red Cross Dynamite is also less expensive than other dynamites.

Red Cross Dynamite is made in the following grades and strengths: Red Cross Dynamite, 20 to 60 per cent.; and Red Cross Extra Dynamite, 25 to 60 per cent. Because it is safest to handle and costs least, we especially recommend Red Cross Extra Dynamite particularly for all blasting about the farm, unless the work is very wet, in which case Red Cross should be used. The only work about the farm for which Red Cross Dynamite is not suitable, is ditch blasting in wet ground with blasting caps and fuse in the middle hole only and well sinking. In the former 60 per cent. Hercules Dynamite, and in the latter 40 per cent. Hercules Gelatin Dynamite should be used and the blasting should be done in warm weather.

RED CROSS 25% EXTRA DYNAMITE CARTRIDGE, 1¼ x 8 INCHES

Safe Handling of Dynamite

There is a popular misconception of dynamite in the public mind. Newspapers in reporting outrages such as bomb throwing by anarchists, safe cracking "jobs" by burglars, etc., incorrectly report them as perpetrated with "Dynamite." The result is an erroneous, widespread impression that a dynamite cartridge will explode if dropped on the ground or thrown against the body of a person.

As a matter of fact, safe breakers and bomb throwers do not use dynamite cartridges at all; they would not be suitable for their purpose because it is so difficult to explode them. What these criminals use as a rule is nitro-glycerin. This dangerous explosive is used commercially for shooting oil wells, etc.

True there is a certain proportion of nitro-glycerin in dynamite cartridges, but the dangerous explosive is scientifically compounded with wood pulp and some other ingredients in such a way that it can be absolutely depended upon not to explode accidentally if our simple and plain instructions for its use are complied with.

One of the safest of explosives manufactured by the Du Pont Powder Company is Red Cross Dynamite, which is especially recommended for agricultural purposes. This brand of dynamite, in practice, is exploded by a powerful shock such as is produced by a strong blasting cap or an electric fuze.

Responsible people can use and handle dynamite just as safely as they can handle gasoline, matches, or coal oil. The energy of dynamite can be directed in the work to which it is adapted just as well as the energy of steam can be directed in the work for which it is used.

Instruction Book Sent FREE

IF the foregoing pages have convinced you that possibly explosives can be used to advantage on your farm, the next questions that will arise in your mind are: How are they used? What do they cost? What quantities are needed? What other supplies or apparatus are needed, etc.? All these things are fully and clearly explained in our large booklet, "The Farmers' Handbook of Explosives," which may be obtained, free of charge, by cutting out and mailing card No. 1 printed on the inside back cover of this pamphlet.

We believe that when you have read the book, you will understand how simple, safe and economical the use of Red Cross Dynamite is, and that you will find many ways to save and make money with its aid.

E. I. DU PONT DE NEMOURS POWDER CO.
WILMINGTON, DELAWARE

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Agricultural Blasting

A MONEY-MAKING PROFESSION

E. I. du Pont de Nemours Powder Co.

WILMINGTON, DEL.

Established 1802.

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    Portland, Ore.—George E. Willman, 230 Stark St.
    Spokane, Wash.--Harry Witt, 523 First Ave.
ST. LOUIS, MO.—W. E Pratt, Mgr., Wright Bldg.
SCRANTON, PA.—Henry Belin, Jr., Pres., E. I. du Pont de Nemours & Co., of Penna.

What is Agricultural Blasting?

T is a new, money-making business, created by us, and in which more than 2000 men are now engaged throughout the United States. It consists chiefly in doing blasting for farmers, nurserymen, orchardists and other landowners to clear land of stumps and boulders, plant fruit trees, rejuvenate orchards, break hard subsoils and dig ditches.

Many Agricultural Blasters also make road and quarry blasts, excavate cellars, blow down old buildings, straighten creek channels and much other blasting of a miscellaneous character.

Do Farmers Need Agricultural Blasting?

HEY need it badly on the majority of farms. Many thousands of farmers know they need it; many others do not know it.

It is the cheapest, quickest and best way to remove stumps, dig farm ditches and plant trees.

It is the only way to remove boulders, break hard subsoils and rejuvenate orchards.

The results of such work mean money to the farmer and he will spend money to get them.

There are millions of acres of stump and boulder land to be cleared, millions more acres of swamp land to be drained, millions of fruit trees to be planted and millions of acres whose subsoil needs breaking.

Much of this work is going to be done this year and more every year thereafter. The chief reason why all live farmers are not having Agricultural Blasting done is the lack of competent Agricultural Blasters to show them the need of it, prove it can be done, and get their orders for the work.

How Much Agricultural Blasting is Being Done Now?

ORE than twenty million pounds of agricultural dynamite was sold to farmers, orchardists and land clearing and drainage companies in 1912.

Is the Work Dangerous?

ES; for men who do not know how to handle explosives, just as it is dangerous for ignorant or untrained people to handle gunpowder, gasoline, automobiles or spirited horses.

But the low strength of Du Pont Red Cross Dynamite and its insensitiveness make it safe to handle and use for any blaster who follows our instructions and uses reasonable care.

How Would You Help Me Get Business?

1. By sending to you farmers' inquiries received from your vicinity through our extensive advertising.

2. By supplying you with advertising matter for distribution.

3. By paying you for dynamite and supplies used in making demonstrations to get business.

4. By keeping in close touch with you by mail and through occasional calls of our special representatives who help you in getting business and solving problems that occur in your work.

How Much Capital is Required?

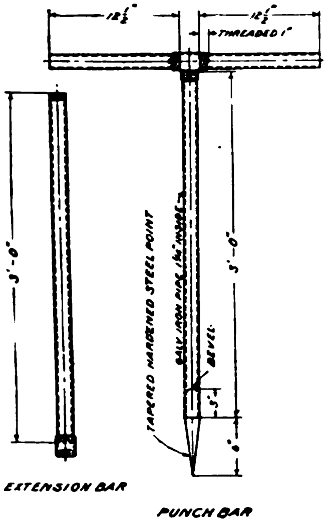
You must have the following outfit:

*1-1½ in. punch bar for making bore holes in earth	$ 2.40
1-1½ in. steel subsoil bar for making holes in hard ground	2.00
1 sledge or maul	1.00
*1-1½ in. wood auger for boring holes in stumps	2.60
*Extensions for punch bar (2)	1.00
* “ “ wood auger (2)	1.00
6 ft. of 1-in. chain with hook	1.00
1 wooden tamping bar (home-made)	
1 chambering spoon	.50
200 ft. Duplex leading wire	2.50
2 lbs. connecting wire	.50
1 No. 2 blasting machine	15.00
1 home-made magazine, capacity 500 lbs	10.00
200 lbs. Red Cross Dynamite (freight prepaid) (100 lbs. 40%; 100 lbs. 20%), about	28.00
500 Du Pont No. 6 caps, about	4.50
100 Du Pont No. 6 6-ft. electric blasting caps, about	3.50
1 Du Pont cap crimper	.40
500 ft. of Crescent fuse	3.00
1 strong trunk or box for tools	15.00
	$93.90

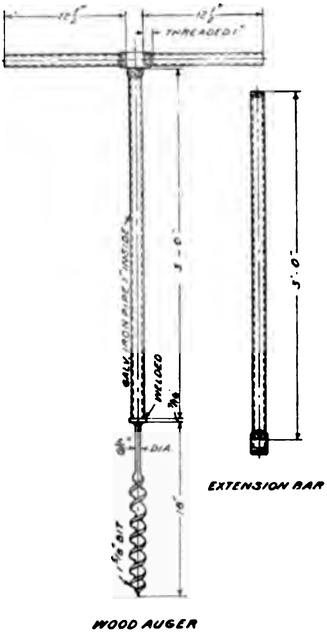
* These tools may be obtained of any hardware dealer or direct from Job T. Pugh, 31st and Ludlow Sts., Philadelphia, Pa., at these prices: F. O. B. Philadelphia, Punch Bar, $2.40; Wood Auger, $2.60; 3-ft. Extensions, 50 cents each. Local prices will run higher to cover freight charges. These tools are made on specifications of the Du Pont Company, and will be all that the average blaster will need for making bore holes in earth or wood.

HOME-MADE TAMPING STICK

STEEL SUBSOIL BAR



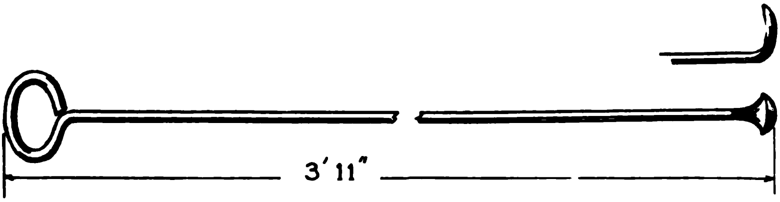
PUGH PUNCH BAR AND EXTENSION



PUGH WOOD AUGER AND EXTENSION

Spoon for enlarging bore holes in earth under stumps.

Any blacksmith can make it in a few minutes out of 5 feet of ⅜-inch steel rod.



One end is bent around for a handle. The other is turned at right angles and forged into a spoon 1½ inches long. In use, the blaster bores a 1½-inch hole to a point under the center of a spreading root stump to a point just beyond the vertical center line. He then inserts this spoon and scrapes the dirt from the sides of the bore hole for about 8 inches from the bottom, lifting the loosened dirt out with the spoon. This makes a chamber about 8 inches long and 4½ inches in diameter, into which the contents of about 12 cartridges may be packed.

This is a better method of chambering than by a small blast, because the latter frequently makes too large a cavity and loosens the ground too much, thus spoiling the resistance.

Every blaster should add this tool to his equipment.

Another plan is to bore the hole about a foot deeper than finally wanted and let the loosened dirt fall into this hole, where it should be packed tight. This obviates the necessity of lifting the dirt out.

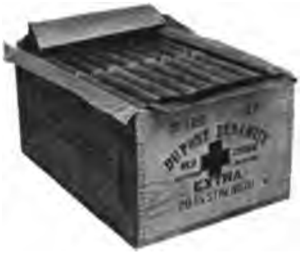
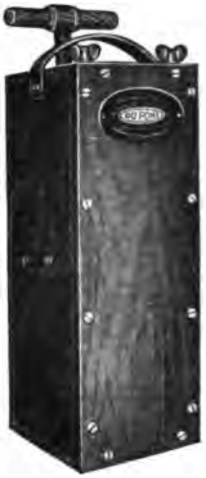
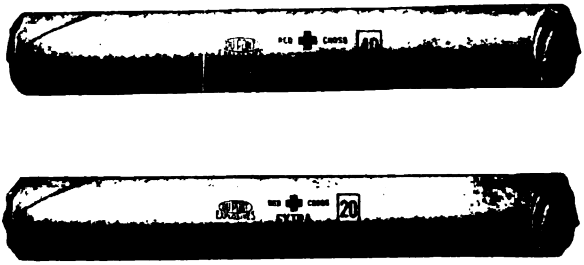


FIG. 83

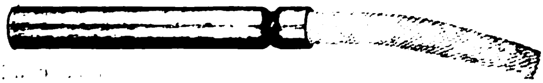


2-POST BLASTING MACHINE



DU PONT NO. 6 BLASTING CAPS

DU PONT CAP CRIMPER



BLASTING CAP CRIMPED TO FUSE

IT would appear from the preceding that if you do a cash business, $100.00 will be sufficient capital to start, but $200.00 will be necessary as you would have to extend some credit.

In localities where licenses are required for storing or using dynamite these would increase the investment from $10.00 to $75.00. In Ohio the license laws are such that none but a blaster doing a very large business can afford to carry a stock of dynamite. The best he can do is to arrange with a jobber to supply him promptly or place orders with us for direct shipment from our nearest mill or magazine. This plan would be good in all cases except that railroad regulations regarding the shipment of high explosives cause serious delays.

Hence if you want to keep busy all the time you must carry a stock or buy of a local dealer who carries stock.

How Do You Teach Men to Become Blasters?

1. By sending them complete printed and illustrated instructions.

2. By keeping all our blasters posted on latest developments through the Farming with Dynamite section of the DU PONT MAGAZINE.

How Would I Charge for My Work?

1. Charge so much for the whole job, you to furnish the explosives and do all the work; or

2. Charge $5.00 a day or whatever amount is satisfactory to you and the farmer for your time, and charge for the supplies as per our farmers' price list, from which listed blasters get a discount of 1½ cents per pound on dynamite, 5% on fuse and 10% on all other supplies. You should also charge for time of helpers 50% more than you pay.

3. If farmer supplies his own explosives, charge him for the work by the day or job.

4. If job is located so you lose a day going or coming you should charge so as to cover this lost time.

How Would I Estimate the Cost of a Job?

The figures in our Farmer's Handbook furnish a basis for estimating, but experience is the best guide. Hence, until you get experience, it would be best to charge by the day, and keep careful records of costs of material and time.

How Much Money Can I Make Per Year as An Agricultural Blaster?

HIS is a difficult question to answer. The most important factor is your own energy and enterprise and ability to regulate your work so as to eliminate all possible lost time.

The second factor is the territory. Little work can be done in Northern States in cold weather. In the South work can be done all the year.

A fairly industrious blaster should average 150 days' employment per year in the North and 250 days per year in the South. In the first instance his earnings at $5.00 per day would amount to $750, and if he used an average of 50 lbs. of dynamite per day and supplies for same, his profit on the goods would be about $1.00 per day or $150 per year. He should also make 50 cents a day on his helper's time, or $75.00 per year. This would make a total for the year of $975. He should do at least this much the first year in the North.

On the same daily basis his net receipts in the South the first year should not be less than $1600. In the second year net receipts should be at least twice those of the first year, owing to greater ease in securing the work, better knowledge of costs, and the probable employment of assistant blasters at $2.50 to $3.00 a day, capable of handling jobs independently at a profit to the employing blaster of several dollars a day. The extracts from blasters' reports to us printed in this booklet give the best idea of the probabilities of the business.

MAKING HOLES WITH PUNCH BAR

Work For Agricultural Blasters To Do

Blasting Stumps

There are still millions of acres of land in the United States which must be cleared of stumps before they can be farmed. There will be enough of this kind of work to keep blasters busy for the next fifty years at least.

Blasting Boulders

Hundreds of thousands of acres of farm land, especially in New England and in the West, are worked with difficulty because of boulders of various sizes lying upon them. Farmers will clear up these boulders gradually as they can afford it, if blasters will bring the matter to their attention and solicit the work.

Blasting Ditches

There is hardly a section in the United States where ditching work cannot be found. The only reason these ditches are not being dug with dynamite at present is because the property owners do not know of the method or do not know how to do it. Blasters who know how to advertise and solicit are getting all of the ditching work to do that they can handle. Wherever irrigation is practical, miles of ditches are necessary and would be blasted if blasters were on the job soliciting the business.

Draining Swamps And Wet Spots

It has been estimated by competent authorities that there are seventy-five million acres of swamp land in the United States. Some of it is in every State. Much of this land could be reclaimed by ditching or by subsoil blasting to break up the impervious strata. There are wet spots of varying areas on fully half the farms of the country which could be remedied in the same manner. Wide-awake blasters will seek out these places and solicit the drainage work.

Planting Trees, Vines, Shrubbery And Hedges

There are about five thousand nurseries in the United States selling millions of trees, etc., annually. Soil conditions are such that fully two-thirds of these should be planted with dynamite and they would be, too, if blasters would properly cover their territories and keep in touch with proposed work of this kind.

Rejuvenating Trees

We have no idea how many millions of fruit and shade trees in this country are not doing as well as they should because of impervious subsoils, but we do know that there are enough of them to keep an army of several thousand blasters busy for the next twenty years.

Blasting Post, Telephone And Telegraph Pole Holes

Work of this kind is obtainable wherever dense soils abound. Like all other classes of work, however, the blaster must look for it and solicit it.

Splitting Logs

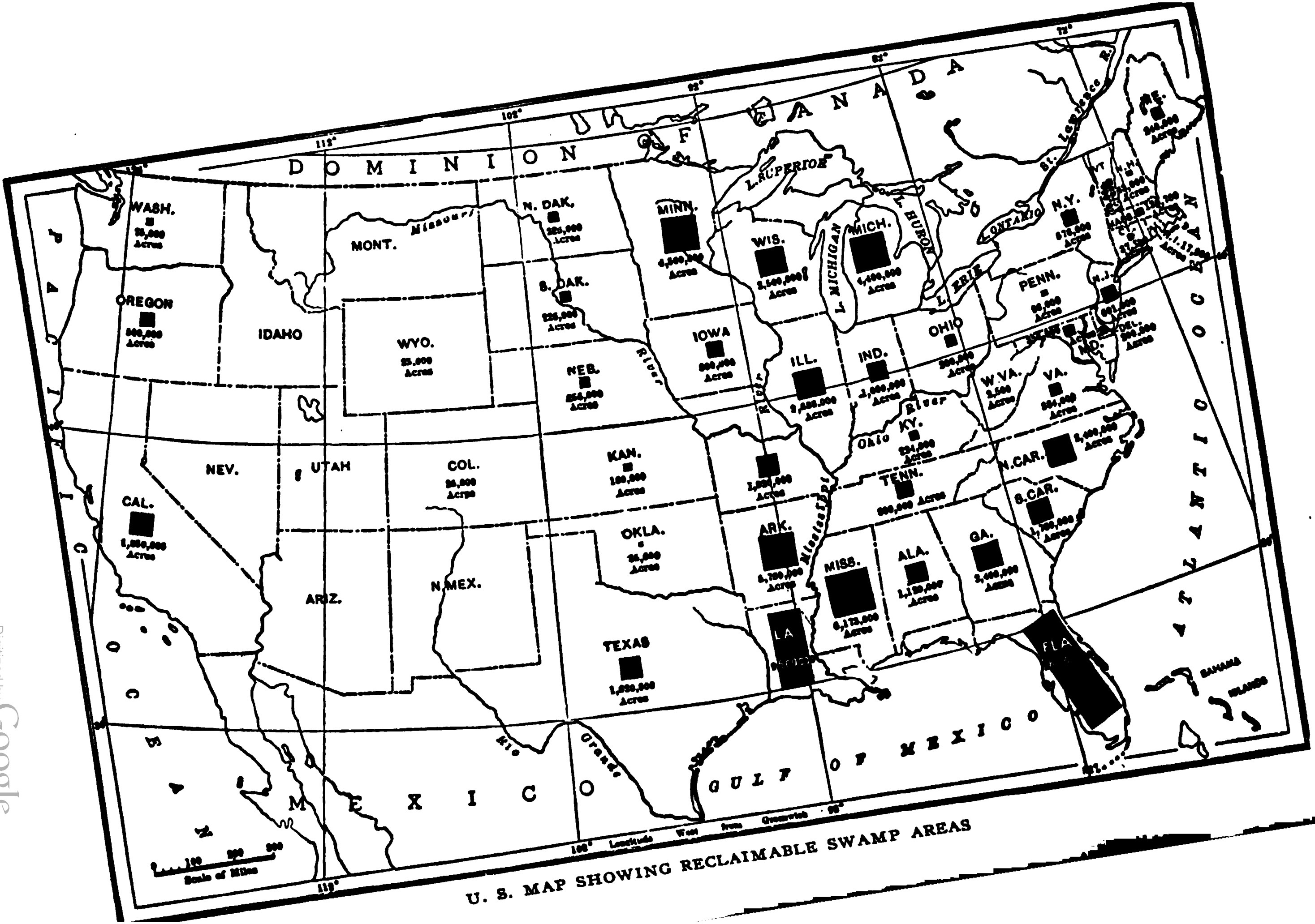
Occasional jobs of this kind can be secured by blasters.

Blasting Wells

Work of this kind is obtainable not only when new wells are being put down, but whenever old wells show a tendency to dry up because of drought.

Blasting Ice Jams

Occasional jobs of this kind can be obtained every winter.



U. S. MAP SHOWING RECLAIMABLE SWAMP AREAS

Blasting Log Jams

This is work seldom obtainable and is found only in logging regions.

Blasting Cellars

In localities where hard soils abound, contractors have to employ crews of men to pick the earth before it can be scraped out or loaded on wagons. Blasters could obtain a great deal of this loosening work and could also blast out many cellars in much the same way that ditches are blasted if they would keep in touch with contractors and builders and solicit the work.

Blasting Trenches, Sewers, Gutters, Etc.

What we have said regarding cellars applies to these classes of work also.

Blasting Masonry or Concrete Walls in Buildings Being Torn Down

Much time is consumed by crews of men in taking down old brick and stone buildings and concrete walls that could be saved by blasting. Blasters who are looking for that kind of work are getting considerable of it to do.

Eliminating Mud Holes in Roads

This title is self explanatory. Such mud holes can be found in country roads all over the Unted States. Road commissioners are the parties to apply to for such jobs.

Blasting Fish Ponds And Reservoirs

Our remarks under cellar blasting apply here also.

Cleaning Out Mill Races, Sluice-Ways, Etc.

We receive numerous inquiries about such work and there is evidently considerable of it to be had by blasters who look for it. Our instructions under ditching cover the method of doing it.

Straightening Channels

Much valuable farm land can be reclaimed by straightening the course of rambling streams. Instructions under ditching apply to this work.

Clearing Right Of Way For Highways

Road contractors need the services of a blaster on almost every road job they undertake. Stumps, boulders, gravel banks and earth are to be removed, and blasting is the quickest and easiest solution of the problem.

Loosening Gravel, Rock, Etc., for Contractors

Securing work of this kind is merely a question of keeping in touch with contractors and letting them know that you are ready and willing to help them.

Breaking Up Steel Castings

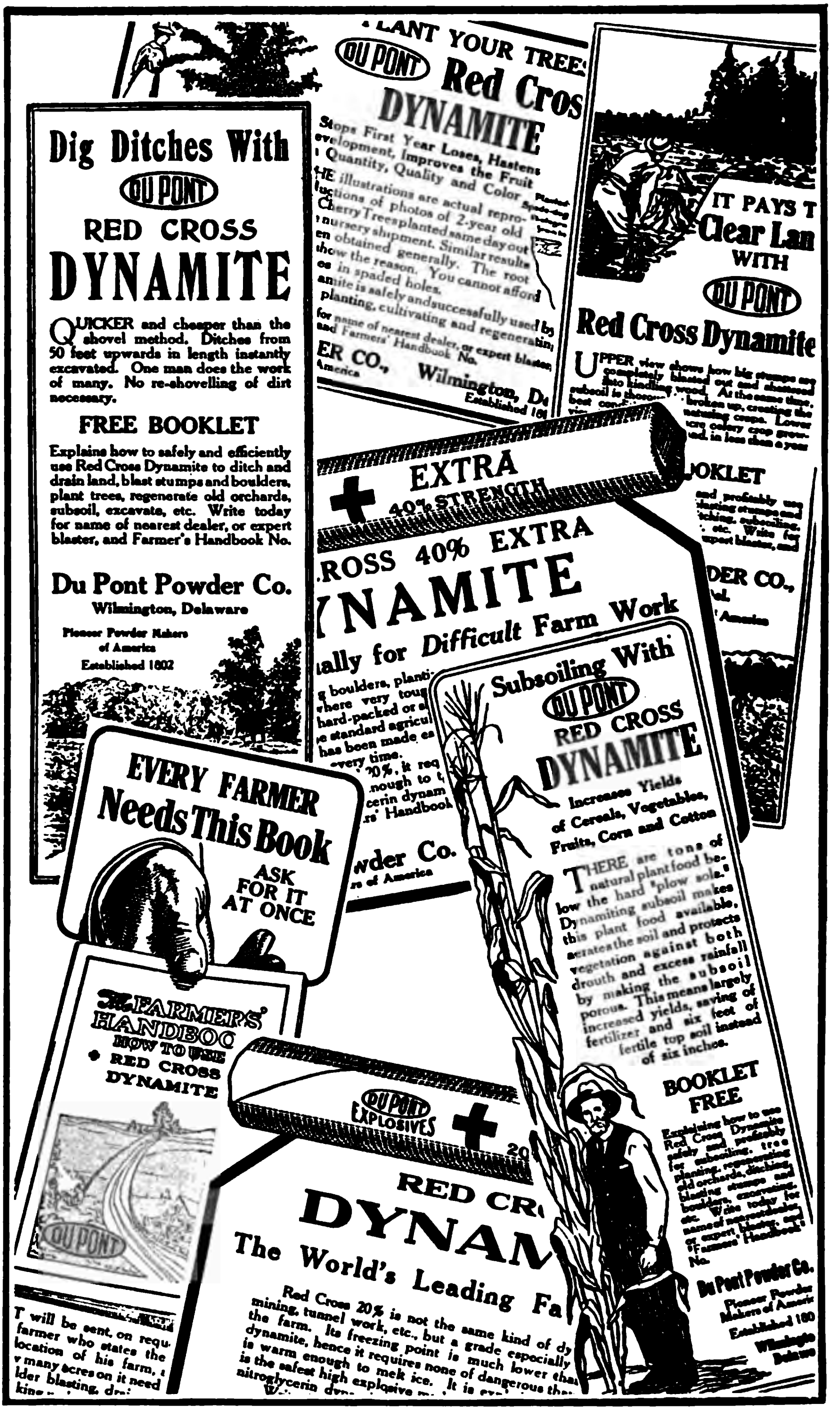
Occasional jobs of this kind can be found by blasters who seek them.

Terracing Hilly Land to Prevent Washing of Topsoil

This is a practice in many farming communities where the land is rolling and the topsoil loose and easily washed. The terracing is expensive and laborious work. By blasting the subsoil as per instructions under Subsoiling, the land can be put in a condition to absorb most of the water and prevent the washing.

Exterminating Gophers And Burrowing Animals

These little pests are very troublesome to thousands of farmers in the western states. They would give a good deal to be rid of them and frequently write us asking how to do it. This is a field that agricultural blasters should cover.



Dig Ditches With

DU PONT

RED CROSS

DYNAMITE

QUICKER and cheaper than the shovel method. Ditches from 50 feet upwards in length instantly excavated. One man does the work of many. No re-shovelling of dirt necessary.

FREE BOOKLET

Explains how to safely and efficiently use Red Cross Dynamite to ditch and drain land, blast stumps and boulders, plant trees, regenerate old orchards, subsoil, excavate, etc. Write today for name of nearest dealer, or expert blaster, and Farmer's Handbook No.

Du Pont Powder Co.
Wilmington, Delaware
Pioneer Powder Makers of America
Established 1802

LANT YOUR TREES
DU PONT Red Cros
DYNAMITE

Stops First Year Losses, Hastens
evelopment, Improves the Fruit
Quantity, Quality and Color

HE illustrations are actual repro-
luctions of photos of 2-year old
Cherry Trees planted same day out
nursery shipment. Similar results
en obtained generally. The root
show the reason. You cannot afford
es in spaded holes.
amite is safely and successfully used by
planting, cultivating and regenerating
for name of nearest dealer, or expert blaster,
and Farmers' Handbook No.

ER CO., Wilmington, De
America
Established 18

IT PAYS T
Clear Lan
WITH
DU PONT
Red Cross Dynamite

UPPER view shows how big stumps are completely blasted out and shattered into kindling wood. At the same time, subsoil is thoro... broken up, creating the best cond... maturing crops. Lower vie... acre celery crop grow... ed in less than a year

OKLET

and profitably use
clearing stumps and
tching, subsoiling,
etc. Write for
expert blaster, and

DER CO.,
el.
America

EXTRA
40% STRENGTH

ROSS 40% EXTRA
NAMITE
ally for *Difficult* Farm Work

g boulders, planti
where very toug
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e standard agricul
has been made ea
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20%, it req
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rs' Handbook

wder Co.
rs of America

EVERY FARMER
Needs This Book
ASK FOR IT AT ONCE

THE FARMERS' HANDBOOK
HOW TO USE
RED CROSS
DYNAMITE
DU PONT

T will be sent, on requ
farmer who states the
location of his farm,
many acres on it need
lder blasting, dra
kin

Subsoiling With
DU PONT
RED CROSS
DYNAMITE

Increases Yields
of Cereals, Vegetables,
Fruits, Corn and Cotton

THERE are tons of natural plant food below the hard "plow sole." Dynamiting subsoil makes this plant food available, aerates the soil and protects vegetation against both drouth and excess rainfall by making the subsoil porous. This means largely increased yields, saving of fertilizer and six feet of fertile top soil instead of six inches.

BOOKLET FREE

Explaining how to use Red Cross Dynamite safely and profitably for subsoiling, tree planting, regenerating old orchards, ditching, blasting stumps and boulders, excavating, etc. Write today for name of nearest dealer, or expert blaster, and "Farmers' Handbook" No.

Du Pont Powder Co.
Pioneer Powder Makers of Americ
Established 180
Wilmingto
Delaware

DU PONT EXPLOSIVES
20

RED CR
DYNAM
The World's Leading Fa

Red Cross 20% is not the same kind of dy
mining, tunnel work, etc., but a grade especially
the farm. Its freezing point is much lower than
dynamite, hence it requires none of dangerous tha
is warm enough to melt ice. It is ex
is the safest high explosive
nitroglycerin dyn

DU PONT ADS THAT ARE PUBLISHED IN FARM PAPERS AND NEWSPAPERS TO GET INQUIRIES FROM FARMERS WHICH WE SEND TO LISTED BLASTERS

General Information for Blasters

Prestige of the Du Pont Powder Company

HIS Company has been established as a manufacturer of explosives for over a hundred years. It is the largest and best known powder manufacturer in the United States. It does more advertising and better advertising than any other concern in this line of business. Blasters who have this Company behind them assisting them as we do in building up a blasting business are indeed fortunate. If they show reasonable energy, persistence, and business ability, there can be no question about their success.

Our National Advertising

INCE the Du Pont Powder Company began advertising farming with dynamite, we have found that there are not nearly enough blasters in the country to take care of the work that farmers have to offer.

We advertise extensively in all of the prominent agricultural and horticultural papers. This advertising produces several thousand inquiries per month. Most of them are from enterprising farmers and fruit growers. The literature we send them convinces them that our methods of stump and boulder blasting, subsoiling, tree planting, ditching, drainage, and rejuvenation of run-down orchards and shade trees and exhausted soils are practicable. As a result hundreds of them desire to try the methods we recommend. Never having used dynamite, however, many of them hesitate to undertake the work themselves, but they write us that they would be glad to employ competent men to do it for them if we could suggest some one.

Referring Inquirers to Blasters

ECAUSE of this demand for the services of blasters, we have established a reference system which gives blasters the benefit of all of our extensive and costly advertising. Some of them are refusing work because their order books are full, while others are engaging assistants to take care of work which they have not the time to do themselves.

Our reference system is worked in this way: When we receive an inquiry from a farmer or fruit grower, we answer it by sending him a letter and a copy of our Farmer's Handbook which tells him all about

MONTHLY DISTRIBUTION FOLDERS

the advantages of using dynamite. We also give him the name and address of a dealer in his locality from whom he can purchase Du Pont explosives. We send the blaster a "yellow slip" giving the name and address of the prospective customer, thus giving the blaster an opportunity for a personal call to look over the proposition and submit a bid for the blasting work.

Local Advertising Matter for Blasters

THE printed matter used in such advertising is furnished to blasters by us absolutely free of charge. Our line of advertising matter consists of:

A. Blaster's Handbills, printed in two colors, upon which the blaster's name and address are prominently imprinted. These handbills illustrate and briefly describe the various classes of work done with Red Cross Dynamite, and offer the services of the blaster.

B. Blasters' Monthly Folders. 100 of these are furnished each month to every blaster who agrees to mail them to a selected list of 100 farmers in his vicinity. Each month's folder deals with one class of farming with dynamite and includes an envelope for mailing out and an addressed printed post card for the farmer's reply to the blaster. The cost of mailing these is but $1.00 a month and the results are usually very profitable.

Gets Six Big Jobs from Circulars

Mr. Jordan, a New Jersey blaster, wrote us less than a month after receiving his supply of the first folder as follows:

> I feel it my duty to write you stating the results of sending out the Tree Planting Folder for November. I mailed eighty of them. The rest I handed out personally. They have solved the problem far better than anything else I could have done. Following is a list of work brought in by them:
>
> Eight acres of stump land to clear.
> Thirty stumps to blast for another party.
> Planting eight acres of peach trees.
> Sinking a pond of water that will take about fifty shots at 30 cents a shot.
> Blasting fifteen big chestnut stumps.
> Blasting six very large boulders.
>
> I am very much pleased with these results and look forward to the receipt of the supply of December circulars. I hope other blasters will profit by this new method.

REDUCED CUT OF POSTER FURNISHED FREE TO MOVING PICTURE HOUSES SHOWING FARMING WITH DYNAMITE FILM

Seventy-eight Replies

Mr. Hill, a Pennsylvania blaster, writes us that he secured 78 replies as a result of the distribution of the 100 Tree Planting Folders we supplied in December to all blasters requesting them. As a result Mr. Hill has been engaged by a number to plant trees and subsoil with dynamite, in addition to which he expects to secure the planting of from 25,000 to 30,000 trees and has also contracted to do 124 acres of stump blasting, some ditching and some boulder blasting. He says he thinks the above proves that the folders are a very good way of advertising.

Sixty Answers in Three Weeks

Mr. Pinney, an Ohio blaster, writing us about three weeks after receipt of the first supply of distribution folders, says:

> I have mailed out all those folders and cards you sent me, and have received answers to sixty of them. They have secured me one big job which will take several hundred pounds of dynamite. The order I am sending you now is part of it, so you will see I am not asleep.

C. Motion Picture Films and Stereopticon Slides. We loan our 1000 ft. Farming with Dynamite film or colored stereopticon slides to blasters who arrange for their exhibition in theatres, at lectures, farmer's institutes, granges, etc. These are great for arousing interest and getting business.

Moving Pictures Bring Contract

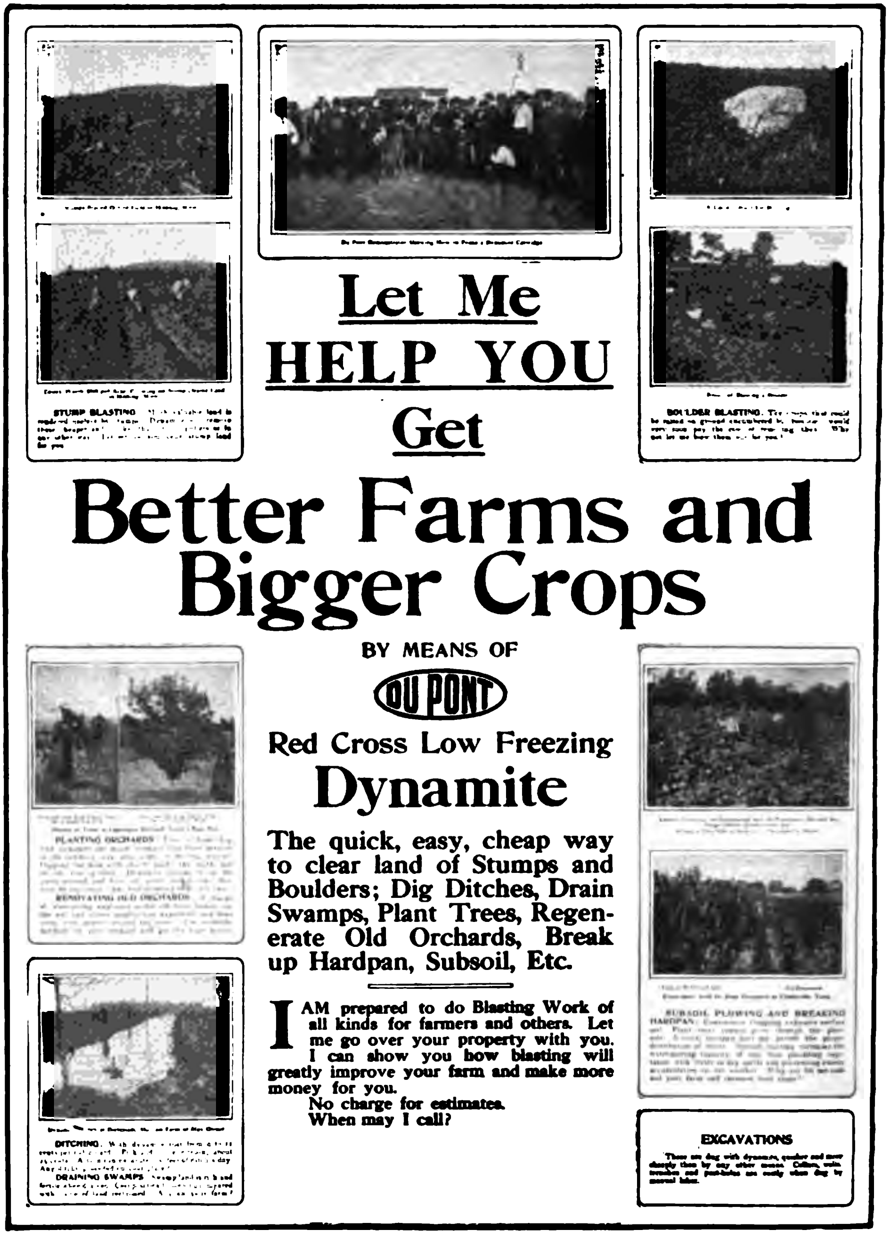
Recently Mr. Alexander, an Indiana blaster, showed the Farming with Dynamite film at a moving picture theater in a small town in his state. As a result of the exhibition, he secured a tree planting contract. He says a great many farmers attended the display and that several of them were very much interested. He expects the exhibition to result in more blasting work for him.

More Business from Farming with Dynamite Films

Mr. W. H. Cattelle, a Pennsylvania blaster, says:

> Your Farming with Dynamite film was shown in a local moving picture house on two evenings. The exhibition brought me two jobs that will require about 100 lbs. of dynamite, 200 ft. of fuse and a box of caps, with prospects of more work from the same parties. The women enjoyed the pictures quite as much as the men.

There are two good points in the above letter. First, the fact that showing the films led directly to blasting work and second, that the


STUMP BLASTING
BOULDER BLASTING
PLANTING ORCHARDS
RENOVATING OLD ORCHARDS
DITCHING
DRAINING SWAMPS
SUBSOIL PLOWING AND BREAKING HARDPAN
EXCAVATIONS

Let Me HELP YOU Get

Better Farms and Bigger Crops

BY MEANS OF

DU PONT

Red Cross Low Freezing

Dynamite

The quick, easy, cheap way to clear land of Stumps and Boulders; Dig Ditches, Drain Swamps, Plant Trees, Regenerate Old Orchards, Break up Hardpan, Subsoil, Etc.

I AM prepared to do Blasting Work of all kinds for farmers and others. Let me go over your property with you. I can show you how blasting will greatly improve your farm and make more money for you.

No charge for estimates.
When may I call?

REDUCED CUT OF POSTERS FURNISHED FREE TO DU PONT BLASTERS films proved interesting to the women. Blasters may not realize it but the women on the farms have a great deal to do with their losing a great deal of blasting work. They are afraid as death of the mere mention of dynamite and if their husbands or sons as much as mention having a blaster come on the premises with the explosive, the women will register objections which spike the deal for the blaster. Letting the women see the films, however, shows them what the work actually consists of and thereafter they are not so much afraid of the actual work.

D. Steel Signs and Fibre Fence Signs. These are furnished only to blasters having magazines and who can therefore offer Red Cross Dynamite for sale. We furnish one enamelled steel sign for house, and 25 fibre fence signs bearing name and address of blaster. These signs tacked up along country roads leading to the blaster's town stir up business.

E. Free Stationery. In order to give our Agricultural Blasters standing as business men in their locality, we have concluded to standardize the business stationery by designing a strong and well balanced letterhead. It is designed in two colors.

We give free of charge to any Agricultural Blaster on our list 500 of these letterheads and 500 envelopes to match, on receipt of certification from our dealer through whom the blaster makes his purchases, that the latter has bought a thousand pounds of dynamite from him, or that customers of the blaster have purchased in the aggregate that amount of our goods and employed the blaster to use them.

F. Free Ad Electro. We supply any blaster free on request with the ad. electrotype shown herewith, which he may insert in local newspapers at his own expense. The cost is not great and if the advertising is continuous (once or twice a week for three to six months) it is bound to get results.

The Du Pont Magazine

[illegible]E publish a monthly house organ called the DU PONT MAGAZINE which includes a section devoted to the interests of Agricultural Blasters. In this section we publish letters from successful Blasters, describing their methods of working, of soliciting blasting work, and telling a great many interesting things about their earnings, experience, etc. This is sent free to all Agricultural Blasters on our list.

REDUCED CUT
STEEL SIGN
FURNISHED FREE
TO BLASTERS
CARRYING STOCK

FARM BLASTING
WITH
DU PONT
RED ✚ CROSS **DYNAMITE**
JOHN DOE & CO. WILMINGTON DEL.

50000 – NOV. 1913 A – 213

REDUCED CUT OF FENCE SIGNS FURNISHED FREE TO DU PONT BLASTERS

Allowances for Free Demonstrations

[illegible]OSITIVELY the most effective means of getting business are free demonstrations, conducted for parties who have a lot of work, can afford to pay for it, and are willing to engage a blaster if he can prove his ability to do the work economically with Red Cross Dynamite.

To encourage such demonstrations we pay Agricultural Blasters $1.50, to cover the dynamite and supplies used, for each demonstration, subject to the following conditions:

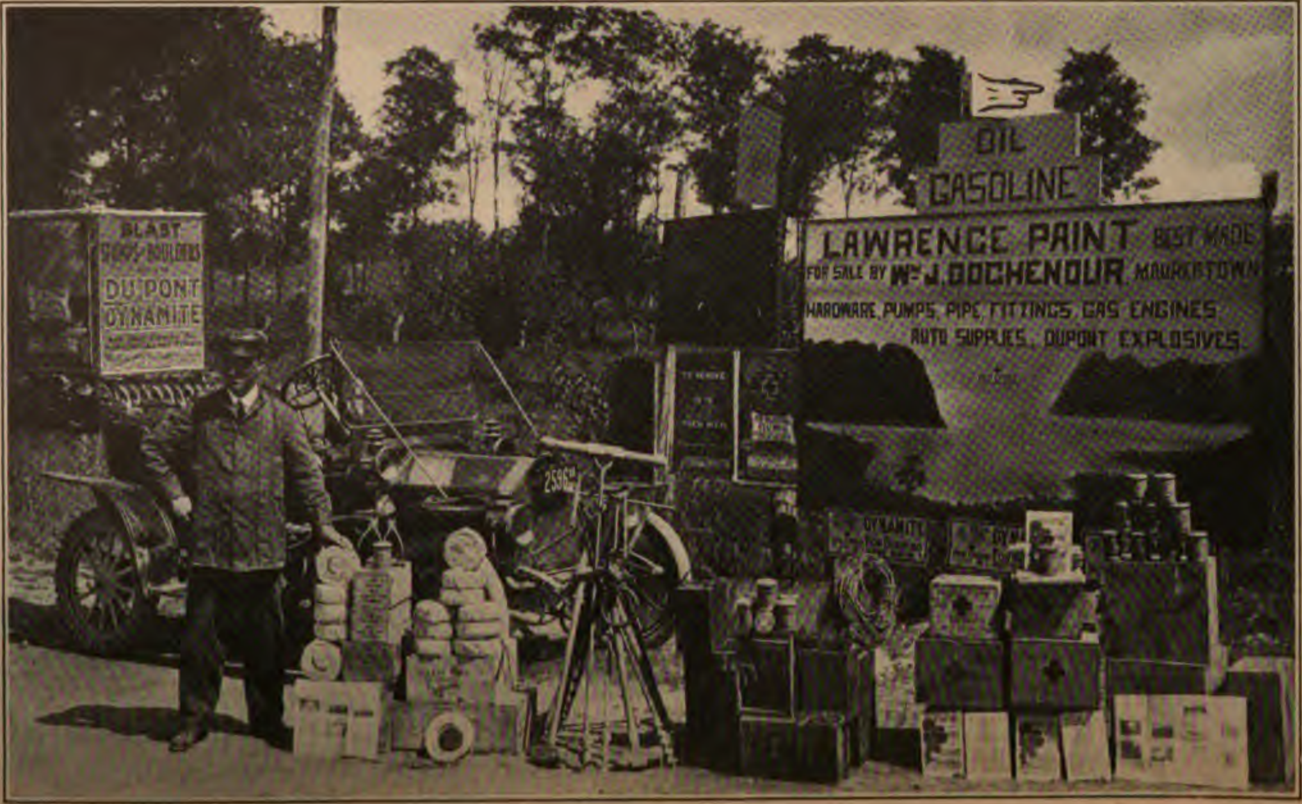
Demonstrations must be made only for farmers who agree to have a sufficient amount of work done to warrant the demonstration, providing the demonstration satisfies them that the blaster can do the work with dynamite economically and advantageously. Each demonstration must be reported on special report form we provide for the purpose. Demonstrations showing no sales results will not be paid for in excess of 30 per cent. for the total number of demonstrations reported. For instance, if a blaster reports ten demonstrations, six of which resulted in the sale of his blasting services, four of which failed to give results, we send him our check for $13.50, covering six resultful demonstrations and three non-resultful.

If blasters have a proper understanding before giving any demonstration and do their work properly, they will not have 30 per cent. of non-resultful demonstrations.

As very little dynamite and supplies are required for demonstrating stump blasting, tree planting, ditching, boulder blasting, or subsoiling, which can successfully and economically be done with dynamite, the

Lowering Primed Cartridge Into Hole   Tamping With Broom-Stick

DEMONSTRATING TREE-HOLE BLASTING


OIL
GASOLINE
LAWRENCE PAINT BEST MADE
FOR SALE BY Wm J. GOCHENOUR MAURERTOWN
HARDWARE, PUMPS, PIPE, FITTINGS, GAS ENGINES
AUTO SUPPLIES, DUPONT EXPLOSIVES
BLAST
STUMPS & BOULDERS
DU PONT
DYNAMITE
DYNAMITE
2596

BLASTER GOCHENOUR, OF WEST VIRGINIA, DISPLAYS HIS FACILITIES

$1.50 payment should be ample to cover the blaster's outlay for explosives and supplies.

The blaster can gain valuable assistance from us under this proposition. He can familiarize all important farmers in his locality with the benefits of blasting with dynamite, and do it largely at our expense. This offer is open to all blasters using our goods and the bigger the checks we have to send them under this offer, the better we like it, provided they are honest in their use of the opportunity and in their reports to us. Should any blaster be so shortsighted as to attempt to deceive us in this work, we will, of course, be obliged to take him off our list. This offer is good only for blasters on our active list. We want every blaster to take advantage of this offer and demonstrate thoroughly in his vicinity, and, in giving out advertising matter and referring prospective inquirers, we are guided by their activity as demonstrators. We want blasters to have plenty of work and we want to sell lots of dynamite, and we know that this is the way to accomplish both ends.

Checks for August demonstrations, for example, are mailed September 15th and so on.

PLACING CHARGE FOR DRAINING POND AT NEWARK, DEL.

How Demonstrations Get Business

Mr. Ziegler, a Tennessee blaster, recently wrote us a letter in which he gave us some advice which will be of service to blasters throughout the country. He says:

> If a blaster will see a man who is interested, give him a demonstration if necessary, and invite his neighbors to witness it, he will in most cases get a job. The neighbors will also want work done. I went to B— County last fall and started in from farm to farm, from a little job to a better one. I was kept busy for four months and when I was compelled to leave, left a number of jobs still waiting for me which parties were anxious to have me do. Had I felt able to continue throughout the winter, I could have gone on all winter and through the spring and summer of 1913 in the one county alone.
>
> In my home county I am getting frequent calls for my services from neighbors. The thing is taking fast in our territory and it is bound to go because people see its benefits. I get the most progressive men first, but you need more blasters in this territory. You give me more references by far than I am able to take care of.

Why a Magazine is Necessary

A BLASTER'S MAGAZINE. VERY CHEAP, BUT PRACTICAL AND PLENTY GOOD ENOUGH

[redacted]O man can expect to be successful as a blaster unless he is in a position to promptly fill his orders for work. To do that, he must either have a stock of dynamite and blasting supplies on hand at all times or must buy through a dealer that carries stock and can make immediate deliveries.

It is futile for any man to attempt to do business as a blaster under any other conditions. Railroads will not handle explosives shipments expeditiously. Doing business with a dealer who does not carry stock is practically out of the question because it takes him from two to four weeks to get your order filled. It is precisely the same if you send us a direct order yourself. It is not our fault. There is no way that we can avoid the delay. Berating railroads does no good. As some philosopher once said, "Facts be stubborn things." When a fact is established, we might as well face it and meet conditions as they are rather than bewail our fate because they are not as we should like to have them.

Either the dealer or the blaster should have a stock of at least 200 lbs. of dynamite and a sufficient supply of caps, fuse, fuzes, etc., constantly on hand so as to be able to take care of blasting work offered without delay. It is not necessary to have any elaborate or costly magazine. Simply comply with the law of your own state on storage of explosives. Surely it is better to spend a few dollars on a small inexpensive store house and upon a stock of dynamite and blasting supplies than to be forced to refuse a large porportion of the blasting work offered you because you are not in a position to do the work at the time the customer wants it done. Not only that, but you can't make a living as a blaster if you are compelled to lose from two to four weeks' time between jobs while waiting for explosives to arrive with which to do the next work. Full instructions for the construction and safe location of small magazines are given in our free Storage Pamphlet No. 1, which also illustrates and prices ready made portable iron magazines.

A BLASTER'S DELIVERY WAGON

Finds a Magazine Profitable

Mr. Rose, an Ohio blaster, writes that he knows of several parties in his section who would like to be professional blasters because they know he is making $5.00 per day regularly out of that kind of work.

He says the reason he is successful is because he constantly keeps a supply of dynamite and blasting supplies on hand so as to be able to promptly take care of any blasting work he may be called upon to do. He also says that while he is doing a good paying business at present he considers prospects good for doing several times as much in the near future, because he is becoming better known and his work better advertised every day. He has used about 700 lbs. of Du Pont dynamite in three months and considers his magazine a good paying proposition.

The Right Way and How It Works

Du Pont Co., Wilmington, Delaware.

Dear Sir: I take great pleasure in telling you brother blasters and dealers of my experience and success in Agricultural Blasting and earnestly hope it may be of benefit to some one, as many little pointers have been to me which I have found in the Agricultural Blaster monthly. I have been engaged in the handling of dynamite for several years, but have not used Red Cross and cooperated with the Du Pont Company, only one year which I will say has been very successful for the first. It pays to co-operate with the Company and the Company's dealers if you want help in securing work as every bit of advertising helps. I do not think, however, that we can secure work by merely sitting at our desks and sending out advertisements. We must, I believe, call on and get out and look up prospective customers. I use a horse and wagon for the purpose. I load up my load, raise my flag and go where I think the work is. I have loaded up four hundred pounds on a Monday morning many times and seldom bring any home with me on Saturday. Of course my jobs are mostly small ones but they are just as good if one can get enough of them. The first of April I had no blasting engaged to do and at the present time I have about fifty small jobs to start. In my spring work it is hard to tell just how much dynamite it will require, so I am ordering 500 lbs. to start the work with and expect to use many hundred pounds this summer. I find it greatly to advantage to have two little fire- and bullet-proof buildings in which I can keep 500 to 1000 lbs. and even 2000 lbs if I need it, so as to have it on hand at all times to avoid waiting for it, as it always takes some little time to get explosives over the road despite the efforts of our dealers. I find it also to advantage to have a good set of tools so that after convincing the farmer of the value and importance of using dynamite you need not take up any more of his valuable time, but just go ahead and do the work. The work itself I believe is our best advertisement. I always aim to make a clean job of it so as never to leave any unfinished work behind me for comment. I run a four-inch advertisment in four of our leading country papers which cover a territory of 40 or 50 miles around me in the two counties which keep the farmers poster that there is a man who will do their work, then nearly always when I approach a man for his work I find he knows who I am and where I am from. I do all lines of Agricultural Blasting so as to find work at one line or another. I think the license fee we have to pay is a good thing, as this will have a tendency to eliminate some of the men who have tried to use dynamite and didn't know how and couldn't learn. For instance, I have cleared up several jobs during the past years that have been made a failure of by some inexperienced man who did not stick to it long enough to learn how, but rather left the farmer thinking it could not be successfully done. Such jobs as these are very difficult to get but they are the kind that bring more.

BLASTER DAVIS
OF NEW YORK

As for the dealer's part I will say he cannot sell dynamite unless some one can handle it, so, brother blasters, let's get out and find the places for it and the dealers will help us as much as possible.

I believe that without any exception Red Cross is the best goods to use for any line of farm blasting.

Your very truly,

(Signed) VERNON DAVIS.

Reports Big Demand for His Services

A Southern Agricultural Blaster gives us the following report of work recently lined up by him:

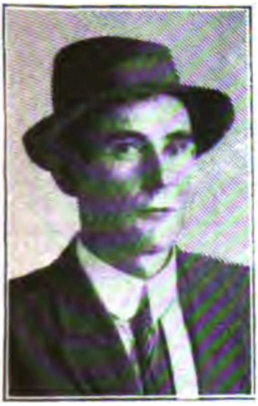
1. One and one-half miles of ditch with option on 10 additional miles, together with several acres of stumps.
2. 535 yards of ditching with more to follow if work is satisfactory.
3. One acre of subdrainage.
4. 1000 acres of stumping at $5.00 per day.
5. A hundred-acre stumping prospect.
6. A fifty-acre stumping prospect.
7. Undetermined number of acres to be cleared. (Owner owns 4000 acres.)
8. 500 acre stumping prospect.
9. One mile of grading prospect.
10. Undetermined quantity of ditching and stumping.

A Blasting Business Conducted on Business Principles

Mr. Carpenter, an Agricultural Blaster in New York State, is one of the most successful men on our list. The reason he is successful is because he conducts his blasting business like a first class business man would conduct a grocery store, a drug store, or any other business. Any one reading the following extracts from a recent letter received from Mr. Carpenter will understand why he is successful. He writes:

I received the booklets. Had a rubber stamp made and stamped each book so that when I give one to a man he knows where to come to get dynamite work done.

I hire a rig and drive out through the country, stop at each farmhouse for a little talk with the farmer and get acquainted with him. I find lots of men have work to do. I leave a booklet with each farmer after telling him about my work. On a recent two-days' trip of this kind, I found about *fifty places* where they want some work done.



BLASTER CARPENTER OF NEW YORK

I have recently been to see a man in a neighboring town who has 7 miles of ditch to blow. I go up there next Tuesday to start the work. I was rcoemmended to this man by a party for whom I put through a tough proposition last summer.

I also have a proposition to blast out 40 acres of willows.

The big swamp job I recently completed I began work on the 20th of August and finished the job on the 28th. When we started the work I wore top boots and the water was above my knees in some places in the swamp. Today, October 6, I went through the same swamp with a pair of common shoes on and hardly got the soles wet and that too was after a heavy rain. That land is now ready for the plow.

I have taken out 387 stumps this week. They were pines, some of them measuring over 7 ft. across the stump and having roots more than 2 ft. thick.

The other day a man whom I have been telling about the great things dynamite would do heard a friend of his mention the fact that he was going to set out

110 FOOT DITCH BLAST, ELK GROVE, SACRAMENTO CO., CALIF.
RED CROSS DYNAMITE IS SUPPLANTING SHOVELS AND DITCH MACHINES ALL OVER THE COUNTRY

BLASTER MATTHEWSON, OF DELAWARE, GETS OUT SIX STUMPS WITH 5½ LBS. OF RED CROSS

2000 trees. He told him to have Carpenter do it and then telephoned me as soon as he reached home. I went out the next day, saw the man and secured the job.

I HAVE OVER SIXTY JOBS ALREADY CINCHED AND AM STILL AFTER THEM.

The above illustrates better than anything that we could possibly say the immense advantage of going right out to the farmers and asking them for their work over the plan adopted by so many blasters of writing them letters about it. The letter is only a weak makeshift. It is never a winner like the face-to-face talk.

Eighteen Months' Work Booked Ahead

Mr. Morris, the North Carolina blaster, in a recent letter to us stated that he had work enough on hand to keep him busy for a year and a half.

He has the right idea of how blasting business should be solicited. To describe his method in his own words:

BLASTER MORRIS OF NORTH CAROLINA

I went down near D— carrying my booklets with me. My first was removing 275 large stumps which I did in 14 hours. While on the work my customer called up his farmer neighbors on the 'phone and I was surprised and amazed at the number of old farmers who came around to see the work done. I then turned the job into a kind of demonstration and after making from 75 to 150 large oak stumps jump out of the ground and turn over nicely, the old gray-headed farmers of from 60 to 90 years of age seeing work of that kind for the first time in their lives grew enthusiastic and eloquent at once. Then I put in a few words for Du Pont dynamite and gave each one a booklet on Farming with Dynamite, a Tree Planting booklet and a blaster's handbill. Then I did some business for Morris. I booked a little over three thousand dollars' worth of work for the summer and fall, consisting of subsoiling and stump blasting because I had convinced them that my way and the Du Pont way was the best and cheapest way.

I have plenty of work, am making good money, am perfectly satisfied, feel good and am proud of my profession. The only complaint I have to lay up against you is that I just can't get all around and do all the work at once and see everybody that is 'phoning, writing and sending word as well as coming after me to work for them. I can stand a heap of work and I love to work and make money but I can't do so much at once. Good reliable assistants are hard to find. I have some helpers but I do all my own loading and shooting and personally inspect every hole or shot that is fired. My aim is to do good work and make good on every job. One price to all. First come, first served, whether large or small contracts. You can always be busy with work that way. I believe I am doing some good for my country and my fellow man. The only time I have to write you is on rainy days when I can't work outdoors.

BLASTER SHOECRAFT, OF FLORIDA (AT RIGHT), AND HIS STUMP BLASTING CREW

BLASTER PETERS, OF FLORIDA (IN FRONT), CONQUERS A BIG ONE

Opportunities and Earnings

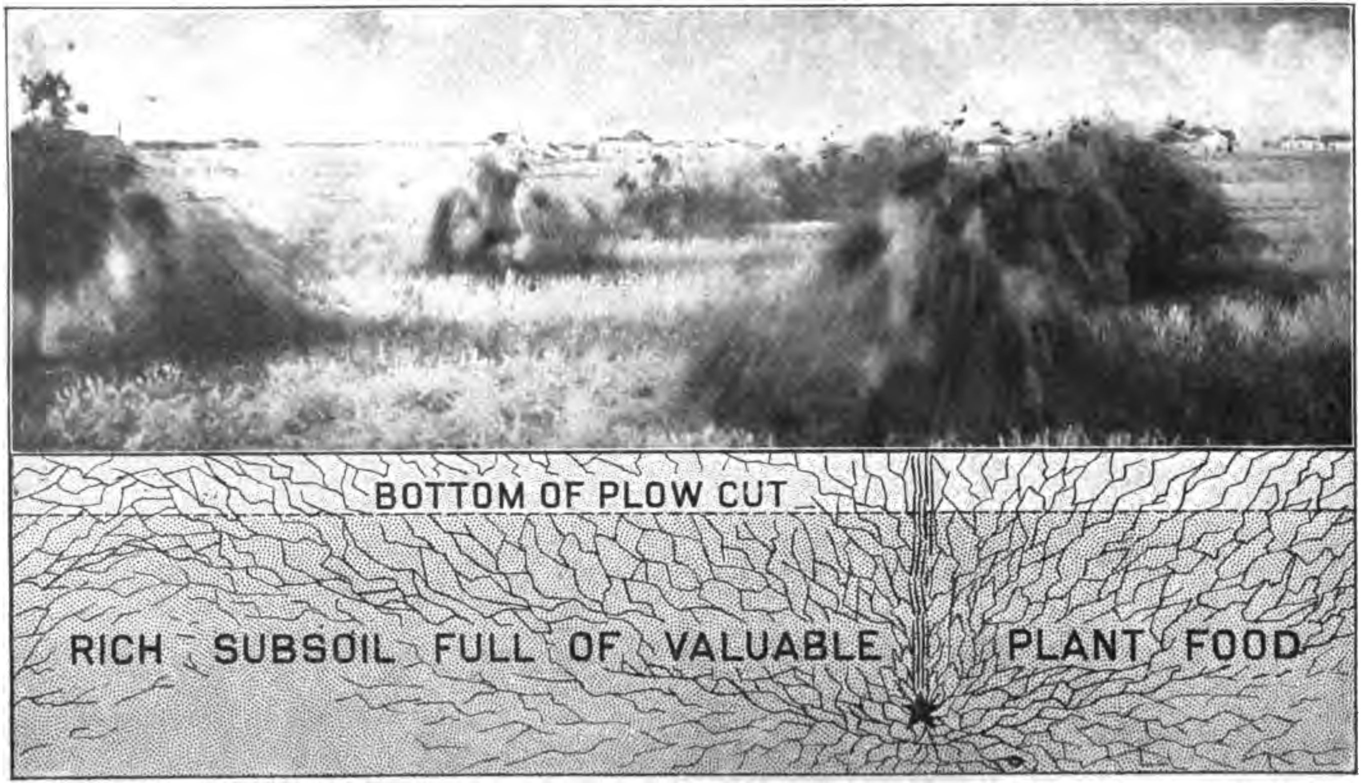
[illegible]CARCITY of farm labor is the most serious problem the farm owner of today has to face. If his own sons were content to remain on the farms instead of seeking occupations in nearby cities, his problem would be solved. The farmer boy is apt to regard the life of a farmer as a humdrum existence, offering slight opportunities for the excitement, amusement and even recompense that the young man craves.

The use of dynamite in agricultural pursuits is very simple and easily learned. Stumping, ditching, subsoiling and tree planting are the largest fields for exploitation. These classes of work are so simple that a man can learn to handle them in a day. The question may be asked, "If it is so simple as that, why would a farmer employ a professional to do the work?" Simply because he is afraid to use dynamite himself. There is something in the word itself that inspires terror, yet properly handled it is no more dangerous than gunpowder, blasting powder, acetylene gas, gasoline, and many other things which farmers very commonly use but which they do not fear because they have become accustomed to them.

In order to show the ease with which blasting contracts may be obtained from farm owners, we will tell the story of a young man that called at the office of a manufacturer of dynamite recently, stating that he would like to take up Agricultural Blasting as a trade but that he did not feel there was any work to be had in that line in his particular locality. Fields always look greener far from home. This man felt that he would have to go off somewhere a thousand miles or more in order to obtain blasting work. He was told that as much of that kind of work could be developed right in his home community as could be found anywhere else. To test it he said, "Well, I will take a horse and wagon and go out on a two days' trip, distributing farming with dynamite literature and talking to farmers and will then return and report results."

Instead of remaining out two days, he was gone just about six hours. He went less than eighteen miles from home and the next day returned to our office all excitement and proclaimed that he had secured so much blasting work to do that he was actually compelled to run away from the locality to avoid taking more business than he could handle. In his little trip he had secured contracts to blast out six acres of stumps, to clear three acres of boulders and to plant three hundred trees.

The few farmers he saw said he was just the man they were looking for to do that work and told him they knew of neighboring farmers

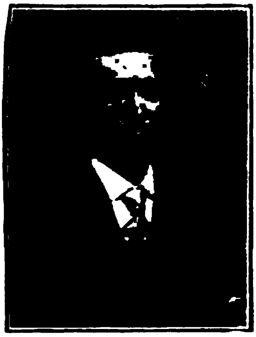


DYNAMITING SUBSOIL—NOTE DEPTH OF PLOWED SOIL AND THE RICH SUBSOIL FULL OF VALUABLE PLANT FOOD
MILLIONS OF ACRES NEED SUBSOILING

who were also looking for some one for the same purpose. He didn't wait to see the neighbors but came back to town to purchase blasting equipment and get help.

Opportunities similar to this exist practically everywhere in the United States. The farmers are looking for the man that can handle their blasting contracts.

To show the earning possibilities of professional blasting: A man operating as an independent Agricultural Blaster in one of the eastern states was recently offered a salary of $6.00 a day by a certain powder company (not the Du Pont Company). He declined the position, stating that he was doing better than that as an independent blaster and enjoyed the additional advantage of being his own boss and master of his own time.



BLASTER HOWARD OF INDIANA

Blaster Earns Nearly Nine Hundred Dollars in One Month

In a sworn report in April, 1913, Mr. Howard, the Indiana blaster, says he earned at blasting $843.65 and used in his work 2941 lbs. of dynamite, 3709 caps and 4947 ft. of fuse.

Doubled His Earnings by Becoming a Blaster

Mr. Schultz, a Massachusetts blaster, writes that he was employed as a checker in a railroad freight house at a salary of $11.40 per week at the time he took up Agricultural Blasting; that since becoming a blaster he has made about double the amount he made at the freight house and has not worked half so hard for the money. Besides, he is more independent. He is his own boss, chooses his own hours and is better off in every way.

Making $200 a Month

One of our travelling representatives in North Carolina reports a recent interview with Mr. Melvin, an Agricultural Blaster operating in that state. He says Mr. Melvin has more work than he can do and that he is averaging earnings of $200.00 per month.

BLASTING STUMPS ELECTRICALLY

GROUP BLAST WITH BLASTING MACHINE, BARKSDALE, WIS.

AFTER THE BLAST, BARKSDALE, WIS.
MILLIONS OF STUMPS WILL BE BLASTED YEARLY FOR A GENERATION

His Business Rolls Up Like a Snowball

[illegible] BLASTER'S business grows like a big snowball rolled about in wet snow. A boy takes a handful of snow and makes a little ball of it in his hands. He throws it down in the wet snow, rolls it around until it finally becomes so large that several boys can't even turn it over.

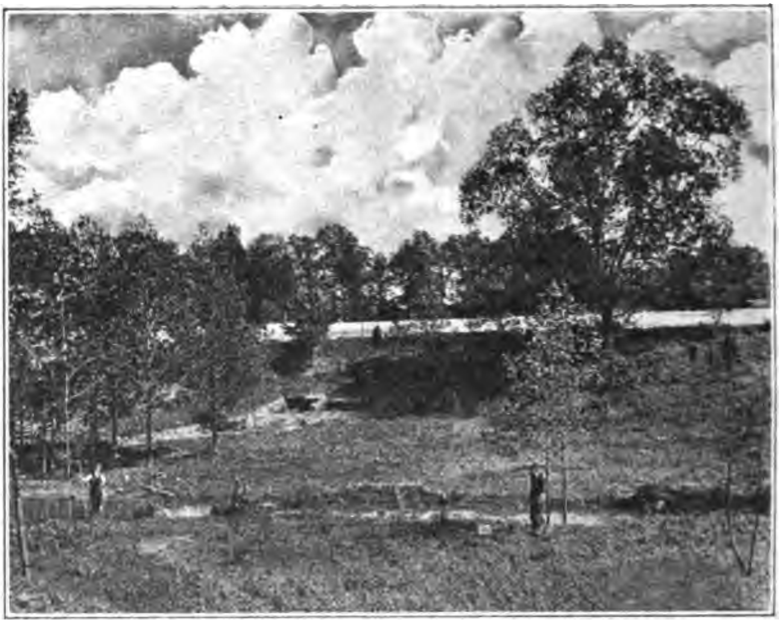
This is exemplified in the experience of blaster Kingsley of California, who writes as follows:

> After buying ten pounds of Du Pont 25 per cent. dynamite to blow a few fruit tree holes on my own place, I was more than satisfied with results and ordered 100 lbs. more at once to finish the job. Before I had finished I blew about 60 holes for another man. By that time another had become interested in the work and I blasted about 800 holes for him. While doing his job I contracted for two other jobs and now have on hand four additional contracts.
>
> Am having a magazine built so that I can keep more stock on hand as I see now I shall have plenty of work. A great many come to look at my work, most of them customers of one of the nurseries here who are interested in orcharding. A great many to whom I have sent my blaster's handbills have written me and I have gone to see them personally and expect quite a number of jobs from them.

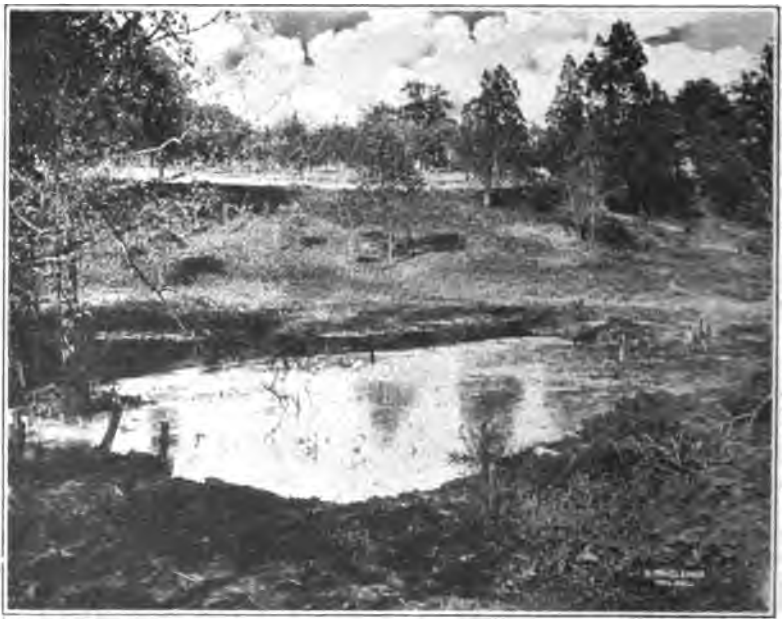
See the difference between going to see people from whom you get a nibble and sending them a postal card or a letter? The blaster who goes to see customers and talks their proposition over with them gets work. The letter writer seldom does.

Mr. Kingsley writes further:

> As soon as I hear of anyone who is going to put out some fruit, shade or nut trees, I send them one of my blaster's handbills. A couple of days later I write them a letter asking for an appointment. I take along my tools and a couple of sticks of 25 per cent. Red Cross and give them a demonstration of the work. After I put in one shot, I can figure what the work is going to cost them and give them an estimate on the job.
>
> If I get the contract to do the work, I have a large sign painted on canvas about 10 ft. long, reading:
>
> This Work Is Being Done By
> W. H. Kingsley, Agricultural Blaster.
> Stop and Investigate and Get Estimates on That
> Tree Planting, Subsoiling and Ditching
> You Have Been Thinking About.
>
> In that way I generally get one or two jobs from every one I am doing.
>
> Most of the jobs I have done so far have ranged from 50 to 400 trees. Most fruit growers are willing to blast for that number of trees so that they may see the difference in results of planting in a dug hole and a blasted hole. If results are good, they will plant in no other way than by blasting in future seasons.
>
> I get on the track of a good many blasting contracts in this way: I have a couple of trees planted in blasted holes right at the nurseries where most people in this locality buy their trees. These trees are a very good advertisement. The nurseryman points them out to everyone who visits the nurseries. The trees



THE OWNER OF THIS LAND WANTED A FISH POND



SOME 60% DU PONT DYNAMITE PROVIDED IT FOR HIM. THIS POND IS 40 X 100 FEET, AND 2 TO 5 FEET DEEP. IT COST TO BLAST $55. A CONTRACTOR WANTED $300 TO DIG IT BY HAND speak for themselves. The nurseryman also gives me a list of people who buy trees from him and I solicit their work.

I just got a contract to blast holes for shade trees here on a large tract. I took the order for the trees also and turned that over to the nurseryman as one good turn deserves another.

I have sold and used about 2700 lbs. of Red Cross dynamite the past two weeks.

Any blaster can make an arrangement such as described above with the nurseryman in his territory.

Using Tons of Dynamite

Mr. Stevens, of Massachusetts, writes:

I have used more than a ton of dynamite the last thirty days and expect to make it two tons in the next thirty days. I have advertised extensively in the local papers and in agricultural papers and at Farmers' Institutes and Grange Meetings. I have taken space at three of the largest agricultural fairs in the State. Whenever I am doing blasting work, I hang a sign by the roadside or near a car line not far from where I am working. The sign reads:

Expert Dynamiting.

....

This land is being . Drained . with Du Pont Dynamite.

....

All Work Carefully Done.
Rock and Stump Blasting, Ditching and
Draining, Tree Planting and Subsoiling.
A. F. STEVENS.

I have buttons at each side of the word "Drained" in the sign and have other pieces of canvas of the same size bearing the words "Cleared," "Subsoiled," etc., which I button over the word "Drained" if I am doing stump or boulder blasting or subsoiling. This makes but one sign necessary for all classes of work. Many people see this sign and come over to where I am working. I have secured considerable business from people attracted to my work in this way.

Some blasters experience difficulty in getting dynamite to points where they are working. I have two acquaintances who own autos. For $2.00 or $3.00 either of them will take me and a man and four cases of dynamite to any job within 30 or 35 miles. This enables me to successfully cover a large territory. Shortly I expect to own an automobile of my own because I like the blasting business and am making a success of it. I am laying out quite a lot of money to get established. Am going about the business in a thorough and business-like way.

Is is any wonder that a man as resourceful and businesslike as Mr. Stevens is succeeding as an Agricultural Blaster?

More from Stevens:

In my last letter I said I was going to give a demonstration in A—. I did so and it was a great success. I enclose a newspaper account of it.

At present I am engaged in removing the stumps and boulders on a 570-acre estate.

Last Friday I attended the Field Meeting of the State Board of Agriculture and there was a demonstration of farming with dynamite given by two of your men.

I put up my posters and gave out about 200 of my business cards. The interest in dynamite blasting was very keen. There were about 950 farmers at the meeting and as probably 90 per cent. of them registered their names and addresses in the visitor's register, I was able to get the address of probably 750 or more of the prominent farmers in this part of the State. I am going to mail one of your blaster's folders to every name on the list. The postage will amount to something to be sure, but I think it will be a good investment in the long run.

I am using as high as four cases of dynamite a week now and before the season ends hope to double that.

I find that in order to get business all I have to do is to convince farmers that I can do the work and let them know that I am in the dynamite business.

Later—Business Increasing Rapidly

In a letter received from Mr. Stevens, shortly after the one from which we quote above, he says:

BLASTER STEVENS
OF MASSACHUSETTS

In my last letter I told you I was using four cases of dynamite a week and hoped to double the amount before long. I have already exceeded my expectations, having used twelve cases the past week.

Work is coming in fine and the outlook for this year is excellent. It is surprising what a lot of jobs I can secure in any one locality from parties who see me at work on another job. I have done considerable advertising and am getting results that are better even than I had hoped for. I have recently sent an order to your New York office for over a ton of dynamite and have hundreds of pleased and satisfied customers to whom I can refer any one.

It is the Man—Not the Locality

[illegible]GRICULTURAL Blasters who are supplied with the right sort of ginger required to become successful business men in any line of endeavor are doing splendidly North, East, South and West.

One of the most successful blasters in the country is Mr. Wilkes, of Connecticut, who has awakened conservative old New England to the advantages of dynamite on the farm. The reason he succeeds is simply because he adopts businesslike methods.

BLASTER WILKES
OF CONNECTICUT

Recently he gave a demonstration at his own expense. Regarding this he says:

I have orders for an immense amount of work ahead. At the Orange demonstration I secured $150 job. At the demonstration on the 17th, I secured 14 jobs and orders for a half a ton of dynamite. I have one contract in Vermont to plant 110,000 trees and clear 1500 acres of land. I must be twenty orders behind now. Does it pay to advertise? Well I guess, yes. My net profits one week were $56.40. The Connecticut Farmer, a prominent agricultural journal published in New Haven, Conn., gave me a good send-off after the Orange demonstration—a front page article with three photos.

Blaster Berkey's Big Jobs in Indiana

Mr. Berkey, the Indiana blaster, understands how to secure work to keep himself and his crew busy. Following are details of some of the large blasting contracts he has recently handled.

BLASTER BERKEY
OF INDIANA

Blasting out 2700 stumps for a farmer in Indiana.

Clearing 40 acres of green stumps for a Michigan concern, this having been the second large clearing job handled for the same firm. These stumps were in loose, sandy soil which other less experienced blasters had tried to get out without success.

A job of stump and boulder blasting for the highway commissioners which he secured by showing them how easily the work could be done with Du Pont explosives.

Blasting the holes and planting 2500 trees for an Indiana orchard company, and blasting 4375 stumps for a physician at the same place.

From Now On I Shall Go After the Work and Not Expect the Work to Come After Me

The above is the motto recently adopted by Mr. Miner, a southwestern blaster. It is a motto that we can recommend to every blaster. Mr. Miner's letter explaining why he adopted that motto reads as follows:

I am still in the blasting business. At first it was slow work for me for I did not go at it right. I thought I could get business by writing letters but I have quit that. I find the only way to get the work is to go to the parties and see them personally, explain the uses of and the effect on the soil of using dynamite.

The first job I took was to blast 20 tree holes for a doctor near here. Before I finished the 20 he increased it to 85. Then one of his neighbors came over and saw what I was doing so he had me blast holes for ten trees. Next I blasted 17 holes for another party and from one to five holes each for a few others. I did not care how small the job was. I took it because I thought it would lead to something better. Then I secured a large job from one of the big companies in the locality. When I began they were using different brands of dynamite. I got them to try Du Pont 40 per cent. Since that time they have used no other, for it has given them better results than any of the others. I have used about 12,000 lbs. of it the past year blasting out stumps on the right of way for building their tramway.

I expect to go up into an adjoining county to give a demonstration shortly as the prospects are good for a big lot of work and sale of a lot of dynamite.

I came very near giving up blasting as a bad job as it looked at first as if there would be nothing in it. I find that was because I did not go at it right to land the work. From now on I shall go after the work and not expect the work to come to me.

Elderly Man Succeeds

BLASTER THOMASSON
OF ILLINOIS

As will be shown from his photograph, Blaster Thomasson, of Illinois, is an elderly man. Nevertheless, his age is not preventing him from successfully conducting a blasting business in which he is using several thousand pounds of dynamite every year. He is employing a crew of several men and was a prominent winner of the monthly bonuses we offered blasters in the early part of 1913.

The Kind of Men Wanted as Blasters

[illegible]GRICULTURAL blasting is a serious, profitable business. It is not an odd-job proposition or filler-in. It is no business for lazy or shiftless men. But it does offer and provide for energetic, earnest workers independence, excellent earnings, health and the happiness that comes from rendering beneficial services in an efficient manner.

The earnings mentioned in the letters in this booklet are not represented as averages. They are the earnings of men of ambition and energy who use their brains as well as their hands, and are enterprising enough to follow the plans and adopt the suggestions we publish in the Du Pont Magazine which every blaster receives free.

There are excellent opportunities throughout the country for several thousand more blasters than are on our list.

This book has been prepared to interest good men to grasp these opportunities, and take care of the big business our advertising is creating and that already arising from spontaneous demand.

Every man who tries to become a blaster gets our help and costs us considerable money. We can save money and prevent disappointments by warning away from the attempt to be a blaster all men looking for "soft snaps," or who expect our advertising to create all the work for them and expect us to hand them profitable jobs "on a platter."

We are spending hundreds of thousands of dollars yearly in developing the agricultural use of dynamite because as there is so much in sight for the next fifty years, it offers big sales possibilities for us. But an amount of dynamite that nets us a profit of a dollar serves for an amount of blasting that should net some blaster $5 to $10.

If you are in earnest and not afraid of hard work, we want you on our list and are prepared to spend considerable money to make Agricultural Blasting a profitable life-work for you, that will make you your own boss, keep you busy at healthy and absorbingly interesting work, and make you an important factor in the improvement of agriculture, and upbuilding the country.

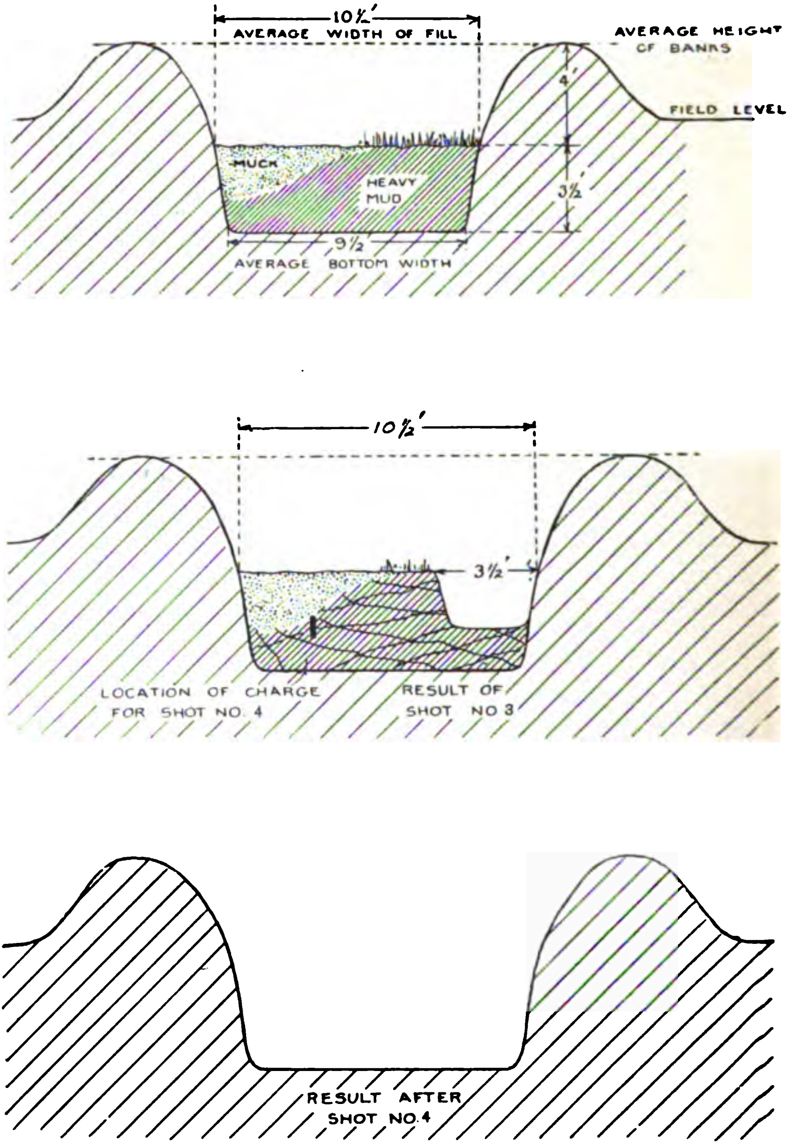
Your success or failure is determined before you start, by your own character and intent. If you are the right kind of man, become an Agricultural Blaster, and the fascination and profit of the work will keep you at it until you are too old to do the work or too well-to-do to need work.

Contrasting the Right and the Wrong Way of Soliciting Blasting Work

IN the same mail recently we received letters from two Agricultural Blasters. The one who is soliciting business in a businesslike way is succeeding splendidly, whereas the other is doing nothing. Their letters explain exactly why this is so.

The successful blaster is Mr. Schiller. His letter says:

I am in receipt of your 25 fiber signs; also circulars. I started out to tack up the signs on roads leading into N—. While doing it I saw several farmers and handed them circulars. This, in each case, lead to quite a conversation in which I explained how I could make their profits larger by subsoiling their land with Du Pont Red Cross dynamite; also told them about planting trees and digging ditches with dynamite. The result was that I got two jobs before I had gone three miles. One was a 90 ft. ditch on which I had fine results. The farmer was so much pleased with it that he became quite interested in dynamite and showed me some apple trees he planted four years ago which were growing very slowly. I told him how I could help them by placing a charge of dynamite in the soil near them. He feared I would blow them out. I told him I would do nothing of the kind and he finally consented to have me blast the soil. To show him the effect of the blasting, I dug a hole near one of the trees and showed him that the roots were penetrating only three to four inches; also explained to him that it was impossible for these roots to grow any deeper on account of the hard ground on which the trees were standing. I had to use a pick to loosen this soil, it was so hard. He said right then and there that the next trees he planted would be planted with dynamite. I then finished blasting around the trees and



HOW BLASTER MATTHEWSON, OF DELAWARE, CLEANED OUT AN OLD MILL RACE the farmer was satisfied that his trees had a chance to grow. He promised me a job of subsoiling later.

The other job I secured will consist of blasting out some trees.

I have handled your brands of dynamite and black powder for the last 21 years. I have always found every stick of your dynamite to be of uniform strength and have learned from experience that this is not the case with other makes of dynamite. Your Red Cross cannot be surpassed by any make for farming purposes.

Contrast the above with the following letter from a Nebraska blaster whose name we shall not mention, because our object is not to humiliate anyone but to show the difference between the right and wrong method of solicitation. The Nebraska man says:

I have been receiving your notices and have written to each man whose address you have sent me. Have also sent him some advertising matter but haven't got any answer from any of them yet.

See the difference? The man who goes out among the prospective customers and shows them what he can do gets blasting work as fast as he can attend to it. The man who wastes his time at home writing letters has only his trouble for his pains. Our advice to blasters is just this: Forget that such a thing as a postage stamp exists. Throw your pen down the well. Use your letter paper to light the fire. Then go out on the farms and show the farmers what an Agricultural Blaster can do for them. You will then be so busy blasting that you will not need your pen and ink because you will be too busy to write letters even to us.

Blasting Partnerships

[illegible]VERY Agricultural Blaster should have a partner. One man in the partnership should be a good solicitor of work, while the other man should devote his time to the actual blasting or superintending the blasting crews if several men are employed.

The blaster who tries to go it alone is working under a serious handicap. The time he uses in soliciting work he gets nothing for, and the time he uses for doing the work he is unable to spend in working up new contracts. With two men in partnership, however, one devoting his time to soliciting contracts and the other to the work itself, the maximum of profits can be made out of Agricultural Blasting. The solicitor is all the time working ahead lining up contracts for the blasting crew. Having the work contracted for ahead in that way makes it possible to place the orders far enough in advance to get the goods on the ground by the time they are needed. Thus there is no lost motion and no lost time.

Besides, many blasters haven't the knack of soliciting. They don't know how to go about securing contracts. Sometimes a blaster drops out of the work altogether because he thinks there is no blasting work to be had in his locality. The trouble is he doesn't know how to solicit.

There is usually plenty of work almost everywhere. We know that because the blasters on our list who have soliciting ability are so busy they have to employ large crews of men to handle their work.

Any way you look at it, it is advantageous for an Agricultural Blaster to have a partner. If he is a good solicitor, then it will pay him to devote his time to that and take a partner to attend to the mechanical details. If he is not a good solicitor, but is strong on the mechanical features, then he should take a partner who can attend to the securing of contracts. In no other way can an Agricultural Blaster make the most of his opportunities.

Compelled to Take a Partner

[illegible]R. HOWARD, one of our most prominent Agricultural Blasters, writes us a very interesting letter from which the following are extracts:

> My business has been so large that I have been compelled to take Mr. Imler as a partner. This fixes it so that I can devote all of my time to travelling and soliciting contracts, while Mr. Imler follows up with a two-horse team conveying men and tools to do the actual blasting work.
>
> I have dealt with your company for several years and now have a contract with you for the delivery of 40,000 lbs. of dynamite. I am at present working the strongest blasting crew I have ever had. Since Spring opened here on April 3 I have ordered my seventh ton. We have worked in nine counties and have contracts in three States.
>
> I travel all the time with a book and pencil taking down the addresses of parties who have stumps or rocks to blast, or subsoiling, tree planting, or drainage work to do. I expect in this way to increase our business enough to require 80,000 lbs. of dynamite per year.
>
> There are a large number of farmers who will order blasting done if they can get credit for a while, so we have prepared ourselves to do work either for cash, or credit, or by time notes. We are well acquainted with a number of the largest banks in our territory who solicit our business.
>
> If necessary my blasting crew can be on the ground in any part of the territory that I cover within a few hours after I obtain the contract to do the work. We are making it a strict rule to do all jobs offered, no matter how small or large, even though we lose a little money on the small jobs, for we figure it pays us to hold the trade in hand.

The manner of handling a blasting business described above is in our opinion the most practical method yet advised. A successful blasting business demands one man who is a good solicitor to get out in advance and line up the work and another man who is a good blaster and crew manager to follow the solicitor and attend to the work. Having wagons or auto trucks for the transportation of the men, tools, dynamite and blasting supplies makes it possible to attend to work promptly and obviates the necessity of losing any time due to railroad shipments.

Working under these ideal conditions, any firm of blasters having the requisite business ability and of sufficient competency as blasters to give satisfaction to their customers, can build up a very profitable business. In fact, there is no reason why they can't become large contractors and get into the same class in a financial and business way as the larger building and railroad contractors.

Opportunities for Blasting Contractors

N an issue of "Engineering and Contracting" there was printed an item which will be of interest to professional blasters and blasting contractors, because it shows that the large contracting magazines are recognizing the Du Pont method of Agricultural Blasting and perceive in the idea an opportunity for blasting contractors to greatly extend their operations.

The article is as follows:

> Blasting operations are another class which the contractor can perform to better advantage than the farmer. We are informed by one of the largest manufacturers of explosives that there has grown up a large agricultural demand for dynamite, a demand so promising that powder mills are likely to have ultimately the chief outlet for their product among farmers and orchardists. Besides the familiar farm uses for breaking up boulders and removing stumps, dynamite is being demanded for tree planting, subsoil plowing, ditching and similar soil loosening operations. According to the manufacturers quoted above the chief obstacle to the development of a very heavy consumption of dynamite for agricultural purposes is the fear of the farmer of handling the explosive. This the manufacturer states is the opportunity for the contractor, and those contractors who have entered the field of Agricultural Blasting are securing all the work they can do.

There is Money and Independence in Agricultural Blasting

R. W. E. Shaffer, one of our Ohio blasters, started in the blasting business twenty years ago. Up to the time of taking up this work he had been a foreman in a tool handle factory which discontinued business leaving him without money or prospects. Observing the large number of stumps that covered the very best land in Central Ohio, he decided that there would be money in it for him to take contracts to remove them. He first tried the stump puller and found it impractical. He then tried dynamite. It was a new idea and there was no one at hand to teach him how to use it. When he first began experimenting with it, the crowds that came out to watch him considered him crazy, but when they found that he could remove stumps so quickly and cheaply, these very same people gave him their land-clearing work. Since that time he has kept crews of from five to twenty men busy on Agricultural Blasting.

BLASTER SHAFFER
OF OHIO

Mr. Shaffer never misses a chance to advertise himself and his work. On both sides of his dynamite wagons is printed in bold letters "W. E. Shaffer, Dealer in Explosives." On the rear is the Du Pont oval. When he hauls a large load of dynamite through the country, he hangs long streamers with "Red Cross Dynamite" printed on them on his wagons.

To give you an idea of the extent of Mr. Shaffer's work, we will tell you that in one year he used 210,000 lbs. of dynamite. During the twenty years he has been in the business he has handled over a million pounds.

When Mr. Shaffer first started out, he had just 75 cents in money and had to borrow to buy his first dynamite. To-day he owns a beautiful home, has an automobile, a road horse, several town lots, stock in a bank and other corporations and is looked upon as one of the most successful men in his county.

He has several large contracts in for this spring and summer.

He is an excellent example of what an Agricultural Blaster can be if he will push his business and he didn't have half the advantages that blasters have now as he had no one to teach him, no manufacturer's advertising behind him to aid him in securing contracts, no one to furnish him posters and booklets free of charge. If a man under these conditions can become moderately wealthy as an Agricultural Blaster, what ought a live blaster be able to do under the conditions that exist to-day?

Great Possibilities

[illegible]E have often mentioned Mr. Stow, a Michigan blaster, in THE DU PONT MAGAZINE. Most of our readers are probably familiar with the name. For the benefit of blasters who have lost faith in the proposition (and we regret to admit that there are a few such), we wish to show what Mr. Stow accomplished in 1912 using his own words:

> During 1912 I devoted only a very small portion of my time to blasting, having a 200-acre farm to work, stock to care for and other business to look after. I have used 4600 lbs. of dynamite and other supplies on jobs secured through the names you have sent me. In addition I have done the work and furnished the dynamite and supplies for 41 other jobs and have 66 more booked.

Mr. Stow is a blasting contractor in the true sense of the term. He doesn't do the actual blasting work but simply acts as a solicitor of contracts, leaving the actual blasting to men whom he employs.

BLASTER STOW
OF MICHIGAN

If Mr. Stow could secure over a hundred blasting jobs in one year, devoting only a small portion of his time to the work, where is the limit of possibilities in the proposition for men who man devote their entire time to it? In this connection it should be borne in mind that Mr. Stow is located in Michigan. The sandy soils of this State are not looked upon as favorable to subsoiling or tree planting with dynamite and we have been told that most of the men who have stumps to blast in Michigan do their own blasting.

Mr. Stow likes our reference slips all right and he has very good reason for so doing. He writes:

> One of my blasters just returned from S—, where he used 600 lbs. of dynamite. This is his second trip there since you sent me the party's name last Spring. He was well pleased with our work and we will use about a thousand pounds for him next year. The same blaster used 400 lbs. for Mr. M— whose name you also sent me recently. We have used 2200 lbs. for Mr. C— W— since you sent us his name and I have still another job booked from him for next year. We used 700 lbs. for Judge F— W— and he has another job for us. After finishing his first job, he wrote me that I had two good men working for me, said they worked with their heads, did not lose a minute's time, nor lose a single shot while on his job. We have a large number of jobs booked for next Spring.

How to Secure Listing as a Du Pont Agricultural Blaster

IF, after reading this booklet, you find you have the necessary qualifications to become a successful blaster, fill in, tear out and mail the form of application following this page.

We will investigate your references, and if they and your answers are satisfactory, we will list you as a blaster at once, if you have had experience, or as soon as you have furnished a satisfactory report of the purchase and use of at least fifty pounds of Red Cross Dynamite in accordance with instruction we furnish free.

Class A blaster is one having a magazine, carrying a stock of Red Cross Dynamite and supplies, and with a cash capital of at least $200.00; or one having no magazine, but buying from a stock-carrying dealer in Red Cross Dynamite and supplies, and with a cash capital of at least $200.00.

Class B blaster is one working at blasting, but who lacks proper facilities for getting Red Cross Dynamite promptly when needed, or lacks the minimum capital required.

In referring advertising inquiries, we refer them first to Class A blasters, as their chances of getting the work are much better than those of Class B blasters. But we will do all we can to help Class B blasters' progress into the A Class.

Now is the time to get started. If we do not receive your application within ten days, we will conclude you are not interested.

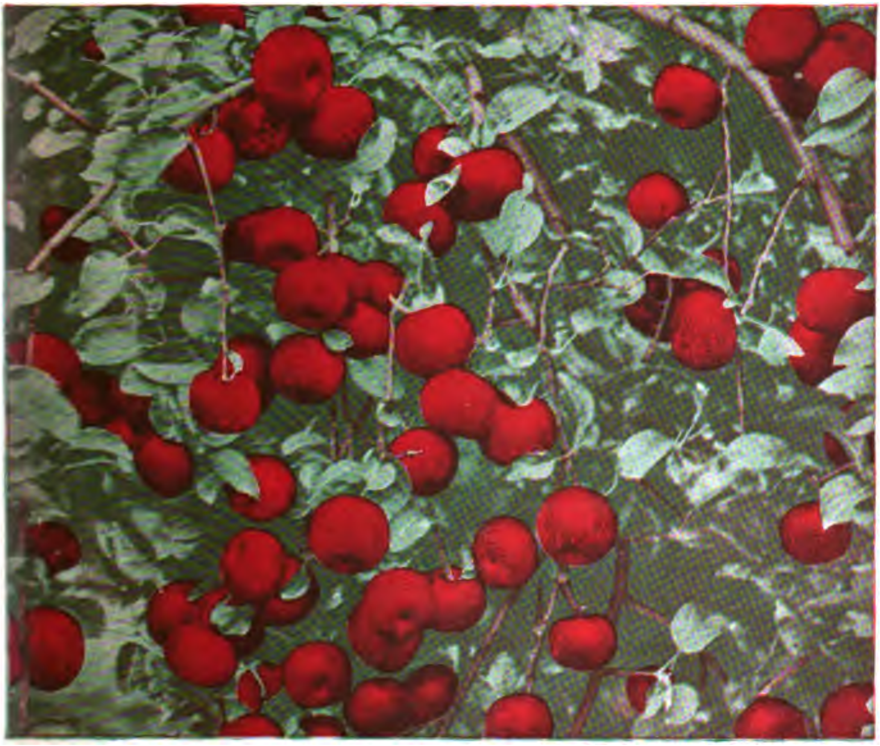
Increasing Orchard Profits

LIBRARY
OF THE
COLLEGE OF
AGRICULTURE

WITH

DU PONT

✚ RED CROSS ✚
Farm Powder



APPLES ON TREE SET IN BLASTED GROUND, WAYNESBORO, VA.

E. I. du Pont de Nemours Powder Co.

WILMINGTON, DEL. ESTABLISHED 1802

Pioneer Powder Makers of America

¶ If you grow fruit, and have never used EXPLOSIVES, the study of this booklet will prove to be worth many dollars to you.

¶ It will save money.

¶ It will increase profits.

¶ It will increase yields.

¶ It will improve yields.

¶ It will make your orchards yield profitable returns on the investment, years sooner and many years longer.

A Proved Proposition

In 1910, the Du Pont Powder Company began to promote the use of explosives in planting new orchards and rejuvenating old ones. The idea was not original with us.

Nearly a quarter century ago, near La Mesa, California, ground was blasted for tree planting, because the orchardist found the work of planting with the spade in his resistant soil too difficult. His experiment was a success. The trees lived, thrived and bore exceptional apple yields for many years.

Other orchardists and farmers in other sections of the country also thought of the same scheme for preparing a home for the tree roots. We have records of such plantings, twenty, sixteen and eleven years ago, before the idea really began to spread.

After we began to advertise it extensively and sent out demonstrators throughout the country, many farmers and orchardists tried the new plan on a small scale. Now, because of the universal success of correct blasting for orchard planting, the majority of fruit trees are being planted in blasted ground.

There remains but three classes of fruit growers who still stick to the old methods:

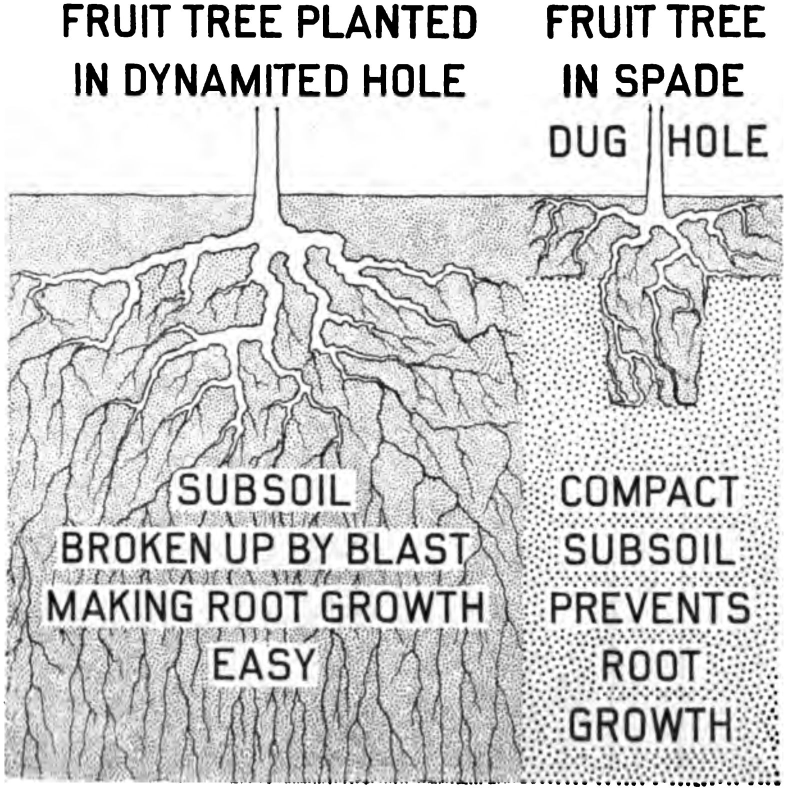
1. Those whom we have not yet reached through our promotion efforts.
2. Those who have tried planting trees in blasted soil without knowing how to do it and hence failed to get satisfactory results, and
3. The class of farmers, orchardists, and horticulturists who decry anything that is new, or which is being promoted by a business concern.

This booklet was printed because the time had come when all doubts of the cash value of blasting an orchard had been cleared away.

Millions of fruit, nut and shade trees have been planted in blasted ground, long enough to prove the great advantages of the method. America's leading orchardists and nurserymen now plant exclusively in blasted ground.

No one can afford to plant trees by any other method except in soil that is loose and sandy to a depth of five or six feet. In such soil blasting is not advantageous except for the elimination of fungus disease, nematoid, etc.

Top of Hole Blasted for Planting Fruit Tree.
(Note radial fissures.)



FRUIT TREE PLANTED IN DYNAMITED HOLE
FRUIT TREE IN SPADE DUG HOLE
SUBSOIL BROKEN UP BY BLAST MAKING ROOT GROWTH EASY
COMPACT SUBSOIL PREVENTS ROOT GROWTH

Diagram of Soil Section.

What Blasting in Orchards Accomplishes

1. It mellows the ground to a depth of five to six feet and throughout a circular area ten to twenty feet in diameter, making it easy to dig the hole and plant the tree correctly.

2. It creates a porous, water-absorbing condition in the subsoil that makes the tree drouth-proof, stopping the big, first year loss.

3. It makes root growth easy and makes tons per acre of new plant food available, hence speeds up the growth of the tree and makes it fruit one to two years earlier.

4. In old orchards that were planted by the old methods and have ceased to bear well, it is of great value in rejuvenating the old trees, causing them to yield heavily.

5. It destroys fungus, nematode, and other orchard soil diseases, hence makes it possible to plant new orchards where old ones have been removed without waiting several years to rest the land and get rid of the diseases.

6. At a cost little or no more than of old-style planting, it causes at least a year's earlier return on the investment in new orchards, and greatly increased returns thereafter as compared with spade-set orchards.

All the above statements are proved in the letters and extracts from letters from experienced users published in this booklet.

Planting a Tree For Keeps

In studying comparative costs of planting fruit trees, the investigator is confronted with widely varying figures and methods.

There seems to be no machine for planting fruit trees such as a corn drill, but the method of some planters approximates the work of a machine in speed, if not in efficiency.

They lay off the site of the proposed orchard in 20-ft. to 40-ft. checks, depending on the kind of trees to be planted. Cross furrows are plowed through the field, marking it off in squares.

One man drives along a furrow with a wagon-load of trees, another lays a tree near each of the furrow intersections, and a third stands the tree in the intersections, kicks some soil over the roots, tramps it down, and moves on to the next intersection. This method expresses a touching confidence in Nature, but results indicate such confidence is misplaced.

A tree that survives such treatment must have as many lives as the proverbial cat, and if it lives, how many years must elapse before it bears any fruit? What grade of fruit can be expected from a tree aged and bent with the fight for existence before it saves strength enough to bear at all.

Going to the other extreme we find a horticulturist advising: "Forget you are about to plant a tree and imagine you are going to bury a horse and dig a hole accordingly. Remember you can only plant it once, and its health and growth, the age at which it begins to bear, and the quantity and quality of fruit borne, depend chiefly on the care and thoroughness used in planting it."

Up to a few years ago, the method followed by most orchardists was to dig a hole about 2 feet in diameter and 18 inches deep, then plant the tree in top soil or a mixture of top soil and subsoil. Under this system the loss the first year ran from 25 per cent. to 50 per cent., depending on soil and weather conditions.

Then tree planting with explosives was taken up by a few orchardists who realized the shortcomings of the ordinary methods, and the necessity of cutting down first year losses, and speeding fruition.

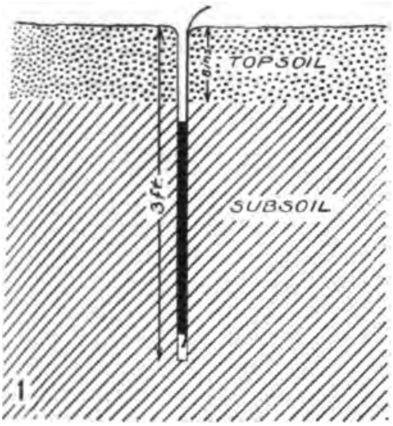
The first objections to the new method were largely financial. The cost of explosives, blasting cap, fuse and labor ran from 8c. to 15c. per hole, whereas trees could be planted with a spade for 3c. to 5c. per hole. The trouble with this comparison is that the work performed is not the same, hence costs should not be compared.

The question involved is, how soon does the planter want a return from his investment and how large a return? The only way to compare costs is to consider the profit sought and which is the cheaper way to get it.

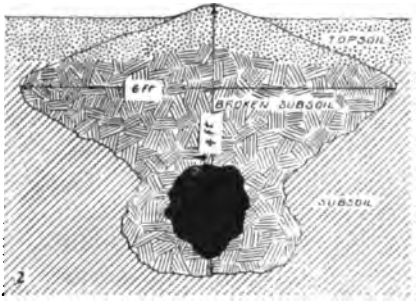
In the first place, the purpose of blasting is not to supplant the spade. It is possible to dig the hole with dynamite, just as a hole may be excavated for a fence post. But the real object of blasting is to mellow the subsoil and make root growth and spade digging easy. A properly placed charge will not excavate a hole at all, but merely puff up the soil. If the blast throws clods high into the air, one of three things is wrong; either the subsoil was wet, the charge too great, or not tamped in enough.

The illustrations show the correct method and the reason why blasting is so effective.

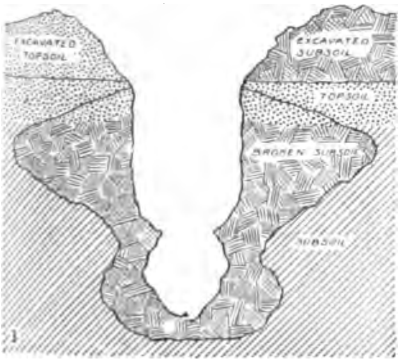
No. 1 shows an inch and a half bore hole, three feet deep, containing one half cartridge Red Cross Farm Powder, primed with a blasting cap with fuse running to the surface. The black area indicates tamping, the amount of which depends on the compactness of the subsoil.



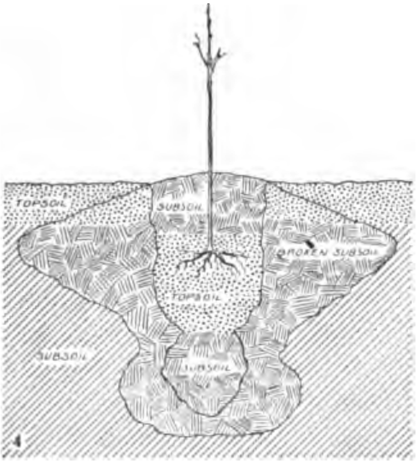
BOREHOLE LOADED, TAMPED AND READY TO FIRE.



APPROXIMATE RESULT OF BLAST IN HEAVY SUBSOIL.



EXCAVATION MADE TO DISCOVER POTHOLE, SO IT MAY BE FILLED.



POTHOLE FILLED AND TREE SET IN TOP SOIL. DEPTH OF ROOTS SHOULD BE ABOUT ONE INCH LOWER THAN IN NURSERY ROW.

The subsoil should be reasonably dry, like top soil suitable for plowing. If wetter, the blast is likely to do more harm than good.

No. 2 shows approximately the condition of the soil after the blast. The subsoil is broken or cracked throughout a circular area shaped vertically somewhat like a vase. Of course, this shape varies in contour, width and depth according to the varying resistances of soils. The black area represents the pot hole formed by the blast in all heavy subsoils, when the charge is properly tamped.

In wet subsoils, the pot hole is larger and there is little or no breaking of the subsoil except vertically. Such a hole would do for planting a telegraph pole, but not for a tree, as the sides would be plastered hard by the blast, making an impervious wall, more difficult for the movement of water or growth of roots than the original compact subsoil.

The pot hole formed in a correct blast, must be found and filled. This is very important. If left open, the subsoil above it will eventually drop into it, leaving the tree roots suspended in the air, causing death of the tree.

No. 3 shows how the hole should be excavated with the spade, the top soil being placed on one side, and the subsoil on the other. As soon as the pot hole is found it should be filled with subsoil, or if available, well rotted manure, old bones, or extra top soil or compost. Such superior filling is hardly feasible when hundreds of trees are being planted, but undoubtedly pays, however, roots should never be allowed to come in direct contact with manure.

After the excavation has been filled to within a few inches of the desired location of the roots, top soil should be thrown in. The tree should be placed on this top soil with the roots in their natural positions, at such an elevation that the trunk will stand in the soil about an inch lower than it stood in the nursery row.

Next throw in the remaining top soil, then get in the hole and walk around, tramping the soil down firmly to eliminate air spaces around the roots. Finally fill the hole with subsoil, with a few inches elevation around the trunk to allow for settling.

The condition will then be as shown in No. 4. This method of planting may seem too troublesome, slow and expensive, but the fact is, it is the most economical and profitable. The object of planting fruit trees, is not merely to get the trees into the ground but to get fruit of salable quality as soon as possible.

The chief objection to starting an orchard is the slow return from the investment. Experience has proved that trees set in blasted ground bear fruit one to two years earlier; the loss from dying trees is practically eliminated, and the benefits of such planting are continuous.

Figure the cost of the trees for an acre of orchard, plus cost of spade planting, plus taxes for the fruitless years, plus 33 per cent. average first year loss of trees, and another year's delay to replace them, plus interest on value of land during the fruitless years. Then figure again using the planting-with-explosives-costs, eliminating the first year losses, and cutting down fruitless years by at least one.

Even if the fruit from trees planted in blasted ground were not superior in size, color and flavor, the financial advantage apparent from the above calculation should cause every orchardists to adopt the blasting method, except those having a deep soil, mellow to a depth of five to six feet, in which case blasting will be of no benefit, except to destroy fungus, nematode, etc.

The Verdict of Practical Experts

The true test of the value of any agricultural or horticultural theory is in commercial rather than experimental trials. The commercial orchardist or nurseryman adopts a new method not out of scientific interest, but because it pays.

Many theories seemingly proved sound in experiment station tests fail to stand up under the varying conditions of actual farming or orcharding. And likewise technical instructors and scientific investigators sometimes fail to recognize the merit of a new method until long after it has been adopted with success by the men who really lead in the industry or art.

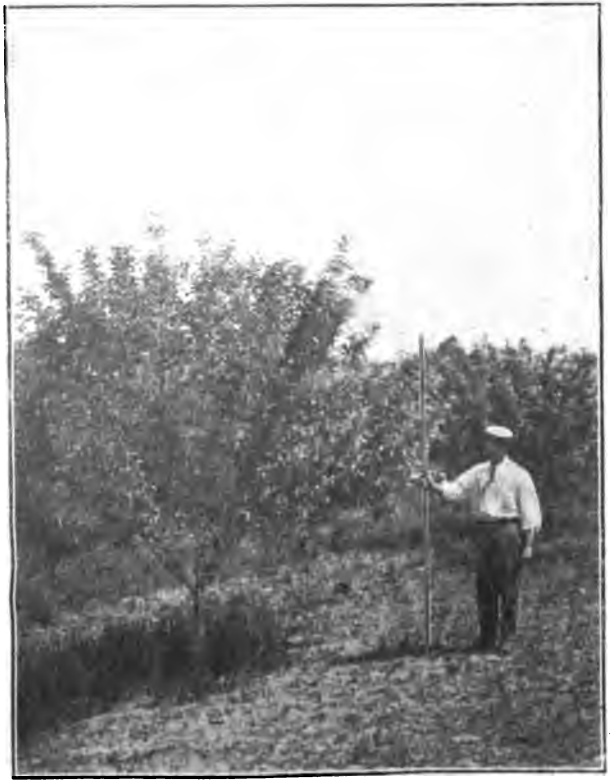
Thus, there are still some pomologists and geologists who are either skeptical as to the value of blasting orchard land, or actually deny its value. We do not question the sincerity of these gentlemen. Instead, we respectfully direct their attention to the overwhelming evidence of those who have to know as printed in this booklet.

To obtain incontrovertible proof that would turn opponents to advocates, we wrote America's leading commercial orchardists and nurserymen, asking them to answer the following questions:

1. For how long and to what extent have you been engaged in fruit culture?
    (The idea of this question is to show what weight may be attached to your opinion.)
2. In what year did you first use dynamite in tree planting?
3. What effect do you observe on the percentage of first year losses of trees set with dynamite as compared with those set in dug holes?
4. What difference in growth have you noted as between trees set in dynamite and dug holes?
5. What differences in the general health of the tree?
6. What differences in the time of maturity and fruition?
7. What difference in the quantity and quality of fruit?
8. From a financial point of view, what are the advantages of dynamiting?
9. What effect has the use of dynamite in tree planting on the conservation of moisture in the subsoil and in resistance to drouth?

Have we permission to publish your replies?

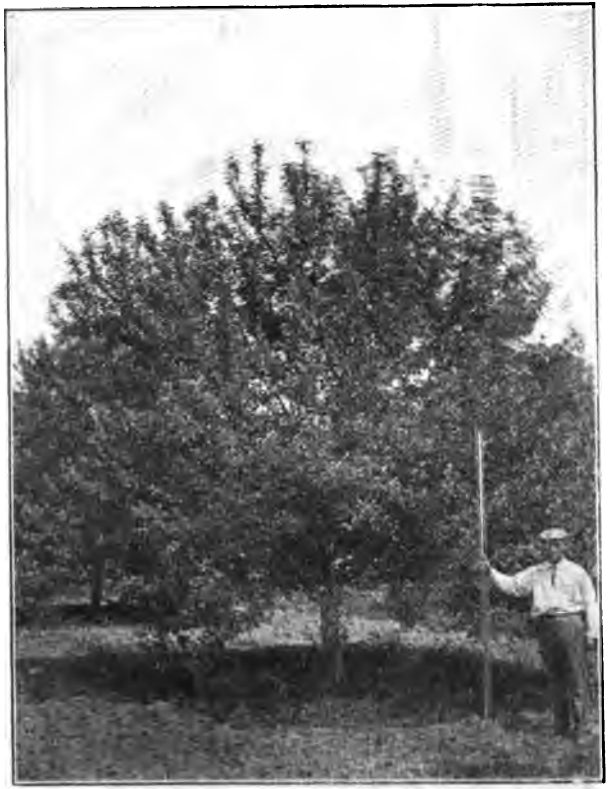
We suggest that you write your replies on your regular business letterhead so we may make a facsimile reproduction of same in a neat



NOT BLASTED.

Nine-year-old apple tree planted in ordinary manner with shovel, same variety and age as tree in opposite cut and not 200 feet away, same soil. Apple trees planted 30 feet apart on square system.

ROSE CLIFF FRUIT FARM.

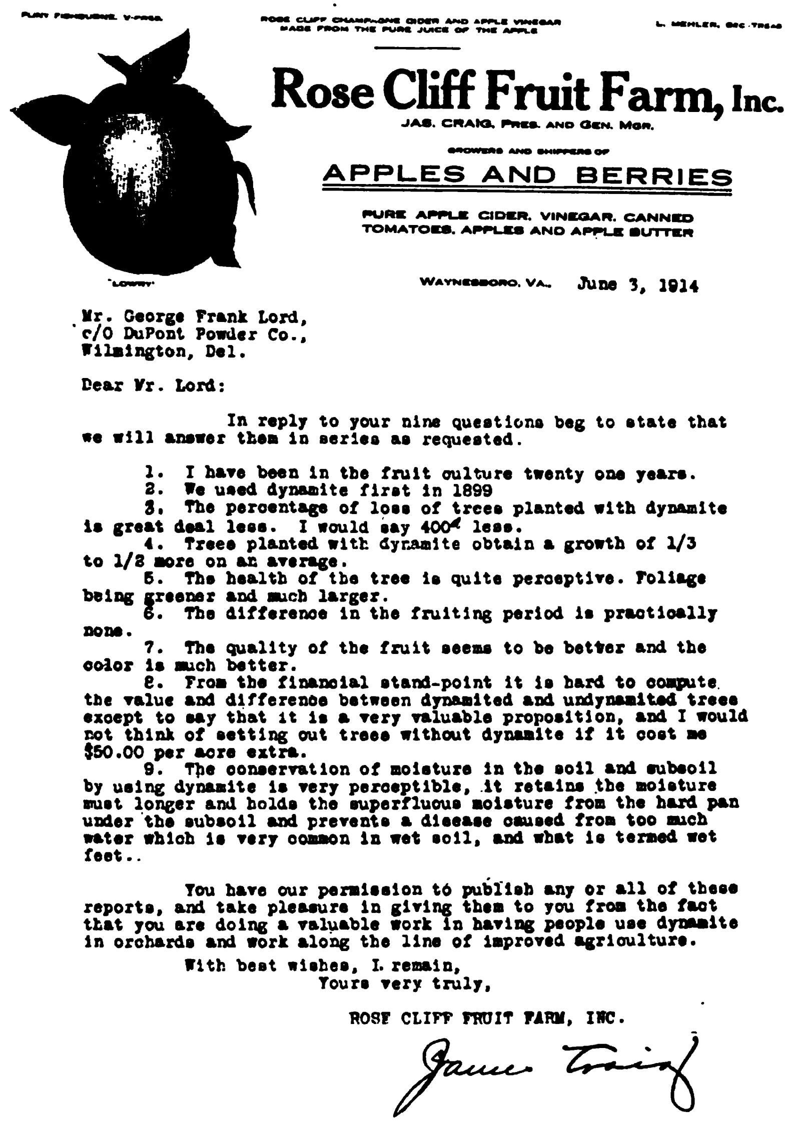


BLASTED.

Nine-year-old apple tree planted in ground shattered with ½ cartridge 40% dynamite placed at depth of 18 inches. Apple trees planted 30 feet apart on square system.

booklet. It will not be necessary to repeat the questions in your letter, but simply give the numbers and your replies, as we will repeat in the booklet the list of questions asked.

Their answers on their own letterheads were photographed and are reproduced in this booklet. Read every one. If you are at all interested in fruit culture, you will be as enthusiastic about orchard blasting as we are.



PLINY FISHBURNE, V-PRES.

ROSE CLIFF CHAMPAGNE CIDER AND APPLE VINEGAR
MADE FROM THE PURE JUICE OF THE APPLE

L. MEHLER, SEC-TREAS.

Rose Cliff Fruit Farm, Inc.
JAS. CRAIG, PRES. AND GEN. MGR.

GROWERS AND SHIPPERS OF
APPLES AND BERRIES

PURE APPLE CIDER, VINEGAR, CANNED
TOMATOES, APPLES AND APPLE BUTTER

"LOWRY"

WAYNESBORO, VA. June 3, 1914

Mr. George Frank Lord,
c/O DuPont Powder Co.,
Wilmington, Del.

Dear Mr. Lord:

In reply to your nine questions beg to state that we will answer them in series as requested.

1. I have been in the fruit culture twenty one years.

2. We used dynamite first in 1899

3. The percentage of loss of trees planted with dynamite is great deal less. I would say 40% less.

4. Trees planted with dynamite obtain a growth of 1/3 to 1/2 more on an average.

5. The health of the tree is quite perceptive. Foliage being greener and much larger.

6. The difference in the fruiting period is practically none.

7. The quality of the fruit seems to be better and the color is much better.

8. From the financial stand-point it is hard to compute the value and difference between dynamited and undynamited trees except to say that it is a very valuable proposition, and I would not think of setting out trees without dynamite if it cost me $50.00 per acre extra.

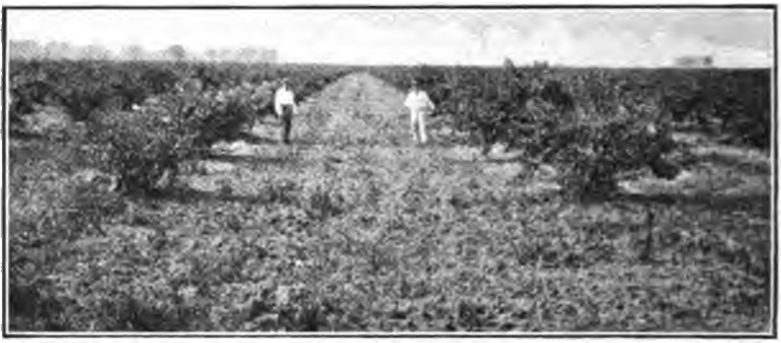
9. The conservation of moisture in the soil and subsoil by using dynamite is very perceptible, it retains the moisture must longer and holds the superfluous moisture from the hard pan under the subsoil and prevents a disease caused from too much water which is very common in wet soil, and what is termed wet feet..

You have our permission to publish any or all of these reports, and take pleasure in giving them to you from the fact that you are doing a valuable work in having people use dynamite in orchards and work along the line of improved agriculture.

With best wishes, I remain,
Yours very truly,

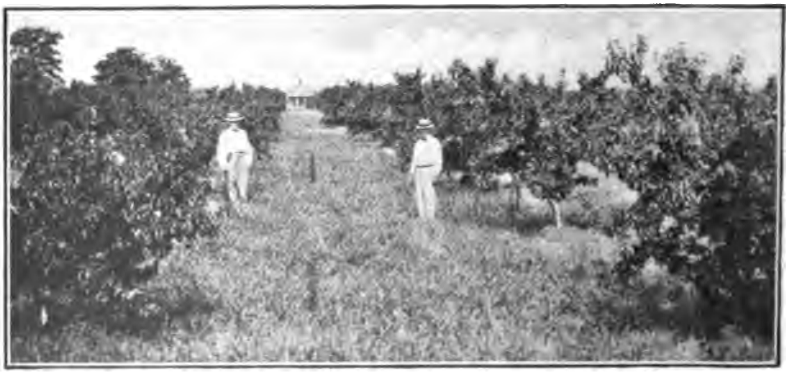
ROSE CLIFF FRUIT FARM, INC.

James Craig



HALE GEORGIA ORCHARD CO. BLOCK OF THREE-YEAR-OLD PEACHES. SEVEN ROWS AT LEFT NOT BLASTED. REST OF ORCHARD, BEGINNING AT RIGHT, BLASTED AND SHOWS 50% MORE FRUIT AND GROWTH.

HALE GEORGIA ORCHARD CO. PEACHES, SECOND SEASON'S GROWTH. ALL SET IN BLASTED HOLES.



HALE GEORGIA ORCHARD CO. FOUR-YEAR-OLD ELBERTA PEACHES. ROW AT RIGHT BLASTED. GROWTH FULLY 50% MORE THAN THE UNBLASTED ROWS.

[illegible]
[illegible]

HALES FRUITS

HALE GEORGIA ORCHARD CO.
EDGEWOOD FARM
LARGEST PEACH ORCHARD IN THE WORLD.

FORT VALLEY, GA. July 9, 1914.

E. I. du Pont de Nemours Powder Co.,
Wilmington, Delaware.

Gentlemen:

Replying to your letter of inquiry of May 28th with regard to the use of dynamite for tree planting, I take pleasure in offering the following observations made on the peach lands of Georgia:

I have been in the orchard business for 35 years and first used dynamite for tree planting on an experimental scale in 1909. During the following year, I blasted 4000 holes on a commercial scale and compared the results as before with trees in unblasted or spade dug holes. The results were that there was a loss of only 2% of trees set in blasted holes and a loss of 50% of the trees set in spade dug holes. Since then on this orchard, we make a practice of setting our young trees only in dynamited holes.

Aside from the benefits in decreasing the death rate of young trees, blasting has resulted in increasing the growth of the young trees as much as 40 to 60% as compared with trees set by the ordinary methods. The vigor of the trees set in this manner has been very marked and the quantity of the fruit produced has been increased very remarkably and we are this year making a careful study of the comparative yields.

From the financial standpoint, the use of dynamite has been very profitable to us. Much of this work has been carried on during very dry seasons but the trees planted on blasted ground retained their color and continued to grow even during the very driest months so it is quite evident that the result of the subsoil shattering was to increase storage of subsoil moisture so that it would tide the trees over the seasons of deficient rain fall.

It was on blasted soil that we perfected the famous Hale peaches.

One block of trees which were bearing poorly on account of nematoids was thoroughly blasted with the result that they put on a very vigorous growth almost immediately and the following season bore a satisfactory and profitable crop.

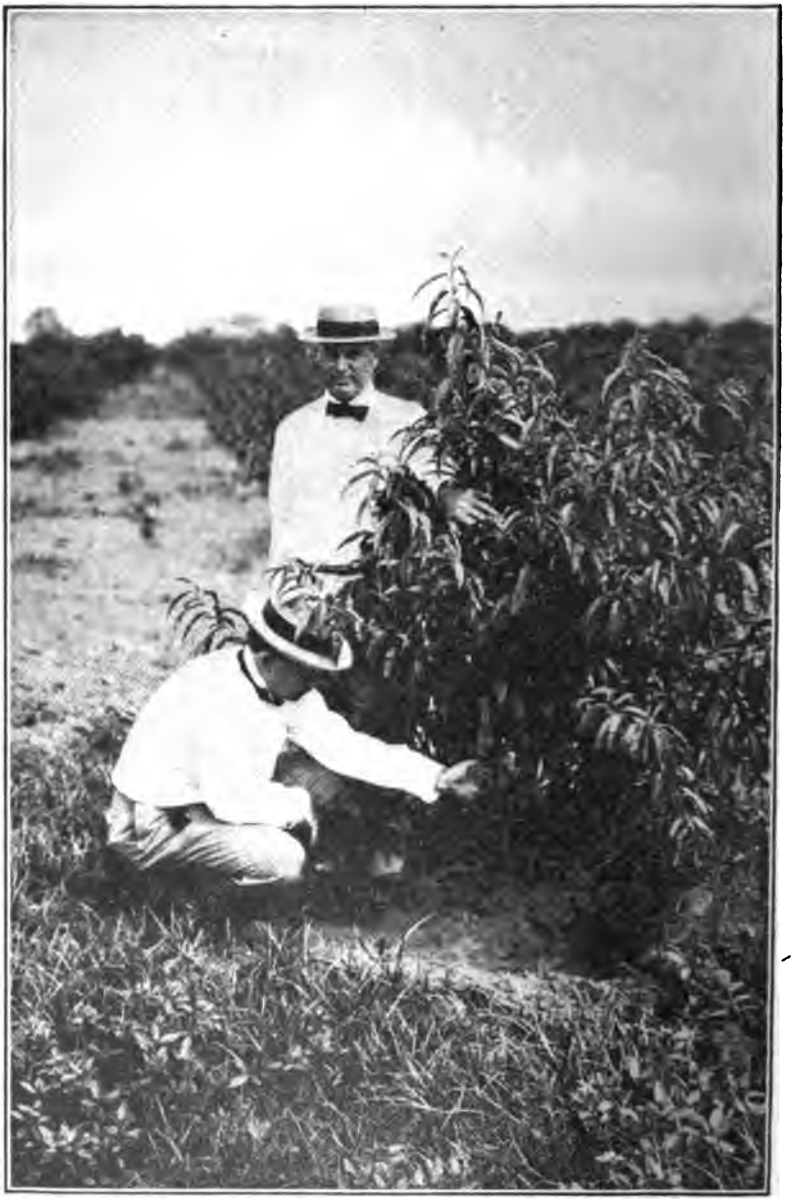
We find, after a large amount of experimentation, that in setting re-plants and re-setting an old orchard, we got an almost total loss of young trees from disease when the holes were plowed or dug with a spade but when these holes are blasted, the young trees grow as well as on virgin soil.

Dynamite has been of great assistance to us in controlling our most harmful plant diseases.

You have my permission to publish this statement of results obtained in the Hale orchards, or extracts therefrom.

Very truly yours,

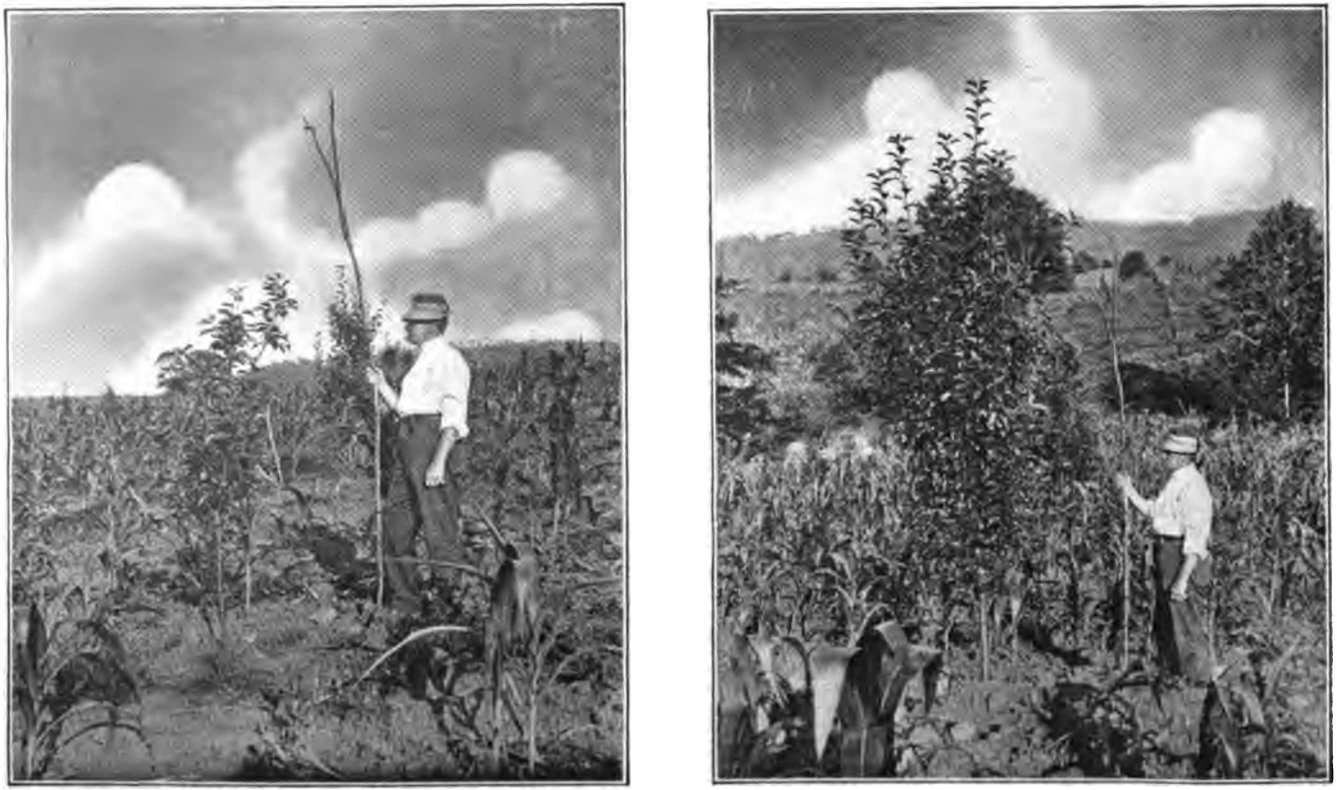
John H Baird
SUPERINTENDENT,
HALE GEORGIA ORCHARD CO.



HALE GEORGIA ORCHARD CO. ONE-YEAR-OLD PEACH SET IN BLASTED GROUND. ALL GROWTH ABOVE THUMB OF STOOPING MAN MADE IN ONE SEASON.

HALE GEORGIA ORCHARD CO. FOUR-YEAR-OLD ELBERTA IN BLASTED HOLE, WHICH HAS ON IT TWO CRATES OF PEACHES.

WHITEHURST & McBRIDE PEAR ORCHARD, CONTAINING 11,000 TREES. SET IN BLASTED GROUND IN SPRING OF 1913. PHOTOGRAPHED ABOUT AUGUST 1, 1914.



PLANTED WITHOUT BLASTING. **PLANTED IN BLASTED GROUND.**

Whitehurst & McBride Pear Orchard Showing Two Trees Planted in Spring of 1913. Photographed about August 1, 1914.

Whitehurst & McBride
WHOLESALE
OYSTERS AND FISH.
NORFOLK, VA.

June 9, 1914.

Mr. George Frank Lord,

Du Pont Powder Co.,

Wilmington, Delaware.

Dear Sir;

Answering yours of June 6th.

Our crohards contain eleven thousand (11000), Keiffer Pear, and Stayman Wine Sap Apple trees, planted with the use of dynamite in the spring of 1913. Four hundred (400), Keiffer Pear and Stayman Wine Saps, planted without dynamite at the same time, all the same lot of nusery stock and under the same conditions of soil and climate. The difference in the two lots of trees is so marked that any greenhorn can tell to the very row, where the dynamite stopped.

We can give you some photograph illustrations that we think would be about as strong an argument as you could possibly get anywhere and if you will let the writer know just exactly how many and what you would like to have, I will endeavor to arrange to furnish them to you. The next time I visit the orchards which is located at Charlottesville, Virginia, and I expect to make my next trip to that point about the first week in July. We also have nine thousand (9000) Old Virginia Wine Sap trees planted in the spring of 1914 on which we used dynamite in every instance.

Referring to your list of questions:

1. About twenty five years as a practical fruit grower on the eastern shore of Maryland, during which time I had entire charge of a bearing orchard of about five thousand trees.

2. During the spring of 1913.

3. Out of eleven thousand (11000), trees planted with dynamite, I lost during the first year, twenty three, out of four hundred (400) planted under exactly the same conditions of soil and climate and directly along side the trees where dynamite was used the loss was one hundred and thirty (130).

4. Dynamited trees made an average growth of over four feet, the first season and in many instances as mush as seven feet. Trees set without dynamite did not average over six inches growth.

5. Very little apparent difference in general health of the trees, as both lots are entirely free from disease of every kind.

6. Orchard not planted long enough to answer.

7. Orchard not planted long enough to answer.

8. Orchard not planted long enough to answer fully, but have every reason to believe that the trees where dynamite was used will come into bearing from one to two years earlier than those where it was not used, which would meanthe market price of the first two crops of fruit.

9. Cant say whether the appearance of the trees where dynamite was used is due to the conservation of the sub soil of whether due to the fact that the roots of the trees instead of running along the surface of the ground struck straight down and pierced the moisture strata below the soil but at any rate, those where dynamite was used show little if any effect of severe drouth of the past six weeks, and have dark glossy foliage, showing about two feet growth this season, while those planted without dynamite have a much more lighter color foliage and have not grown more than twenty five per cent as much as the others.

You have full permission to publish any of the above information which may be of interest to you and if at any time any of your representatives should happen to be in Charlottesville, Virginia, where our orchard is located, will be very glad to have him visit the place and see the results for himself.

If we can be of any further service to you, let us know and we will be glad to do so.

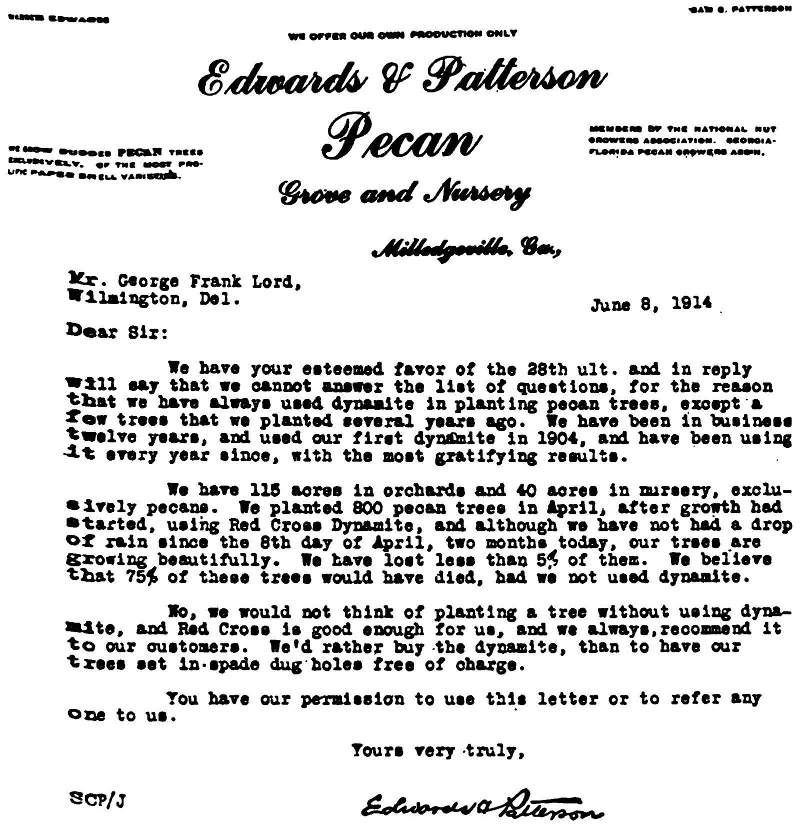
Yours very truly,

J A McBride

Treas. & Manager.

Bellemont Orchards, Inc.

EDWARDS & PATTERSON PECAN GROVE. ALL TREES SET IN BLASTED GROUND.



[illegible] EDWARDS

SAM C. PATTERSON

WE OFFER OUR OWN PRODUCTION ONLY

Edwards & Patterson
Pecan
Grove and Nursery

WE GROW BUDDED PECAN TREES EXCLUSIVELY. OF THE MOST PROLIFIC PAPER SHELL VARIETIES.

MEMBERS OF THE NATIONAL NUT GROWERS ASSOCIATION. GEORGIA-FLORIDA PECAN GROWERS ASSN.

Milledgeville, Ga.,

Mr. George Frank Lord,
Wilmington, Del.

June 8, 1914

Dear Sir:

We have your esteemed favor of the 28th ult. and in reply will say that we cannot answer the list of questions, for the reason that we have always used dynamite in planting pecan trees, except a few trees that we planted several years ago. We have been in business twelve years, and used our first dynamite in 1904, and have been using it every year since, with the most gratifying results.

We have 115 acres in orchards and 40 acres in nursery, exclusively pecans. We planted 800 pecan trees in April, after growth had started, using Red Cross Dynamite, and although we have not had a drop of rain since the 8th day of April, two months today, our trees are growing beautifully. We have lost less than 5% of them. We believe that 75% of these trees would have died, had we not used dynamite.

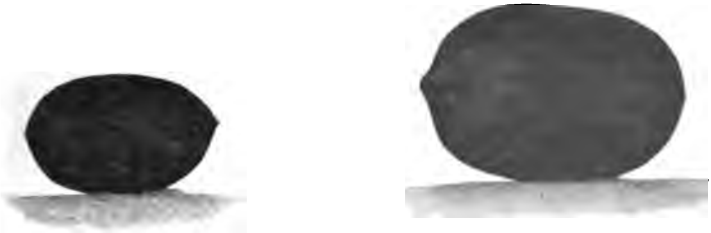
No, we would not think of planting a tree without using dynamite, and Red Cross is good enough for us, and we always, recommend it to our customers. We'd rather buy the dynamite, than to have our trees set in spade dug holes free of charge.

You have our permission to use this letter or to refer any one to us.

Yours very truly,

SCP/J

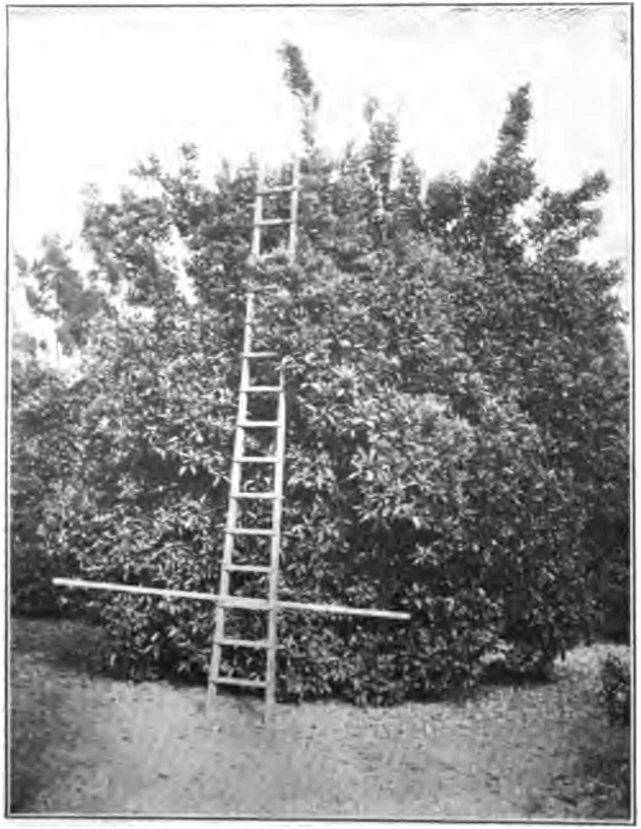
Edwards & Patterson

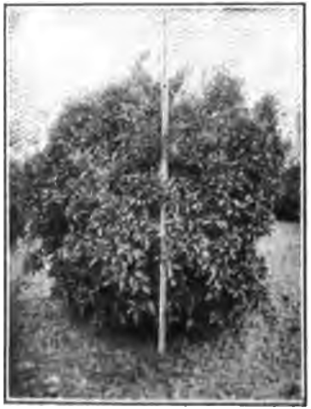


EDWARDS & PATTERSON PECANS, ACTUAL SIZE, SENT TO US AS FAIR AVERAGE SAMPLES OF NUTS GROWN ON UNBLASTED AND BLASTED TREES, THE NUT TO THE RIGHT BEING FROM A TREE SET IN BLASTED GROUND.

18-Year Test Proves Value of Dynamite in Tree Planting

Cut at left shows a Valencia orange tree, now 20 feet high, planted with dynamite, January, 1896, in grove of E. C. Franzen, Santa Ana, Calif. The lower right cut shows same kind of tree, now less than 10 feet high, planted same time with spade in same orchard, both trees having received the same treatment since then. The middle cut shows Mr. Franzen standing in an excavated blasted treehole in his orange grove.





JAMES CRAIG, PRESIDENT
[illegible], VICE-PRES.
[illegible], SECRETARY

OWNERS OF 3000
ACRES OF THE BEST
FRUIT LAND IN VIRGINIA

SHENANDOAH VALLEY APPLE LANDS CO., INC.

OFFICE: FIRST NATIONAL BANK BUILDING

WAYNESBORO, VIRGINIA May 20, 1914.

Mr. George Frank Lord, Mgr.
Agricultural Division,
Wilmington, Del.

Dear Sir:

REPORT ON TREE PLANTING WITH DYNAMITE.

No. 1.- I have been closely identified with commercial apple orchards for ten years and directed and supervised the planting of some 750 acres on the Blue Ridge Mountains in land with a stiff clay subsoil.

No. 2.- My associates started using dynamite in 1902 and I have continued the practice and have been closely following the results for some seven years.

No. 3.- During the dryest years we have planted, 97% to 100% of our dynamited trees lived as against 75% dug hole trees. One thirty acre orchard planted with a half stick of 30% dynamite to each tree hole shows a loss at the end of the first year of but two trees. We figure that even in favorable seasons more than 10% of trees will die in dug holes.

No. 4.- The difference in growth is 60% to 75% better in dynamited holes. I trust the dynamite every time because in dry May and June I get a rapid growth which enables me to shape the head early the frist growing season.

No. 5.- The general health of the dynamited planted tree is uniformly vigorous.

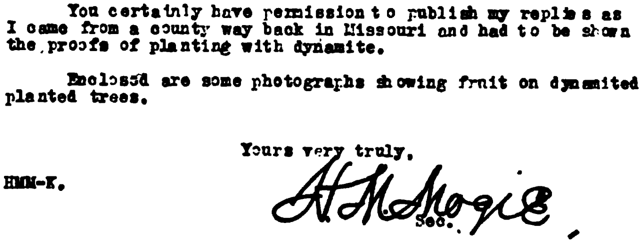
No. 6.- Our varieties fruit one to two years earlier. from dynamited holes but the fruit wood is so vigorous and strong that we really get in the money crops three years earlier.

No. 7.- Dynamited planting wins out in both quality and quantity of fruit.

No. 8.- From a financial view point dynamiting tree holes saves from $66to $8. an acre and there is always a valuable saving in time of planting.

No. 9.- Dynamited tree planting is drought insurance. I walked

through a young orchard this morning planted on a rocky hill side that several orchardists said would not grow trees that your expert, Baskerville, dynamited for me and the trees so far this year have made a twenty-four inch growth -- across the fence and some dug hole trees that have not grown more than six inches this season.



You certainly have permission to publish my replies as I came from a county way back in Missouri and had to be shown the proofs of planting with dynamite.

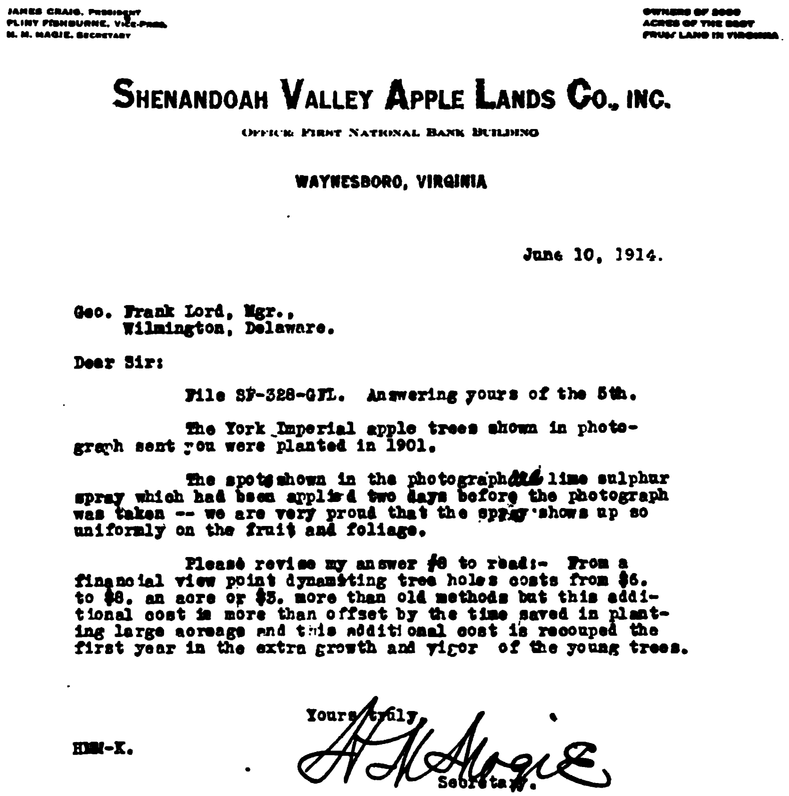
Enclosed are some photographs showing fruit on dynamited planted trees.

Yours very truly,

H M Magie
Sec.

HMM-K.

NOTE.—Fearing that the spotted appearance of the apples in the photographs sent by Mr. Magie might occasion adverse comment, we wrote asking him to explain the cause. He replied as follows:



JAMES CRAIG, PRESIDENT
FLINT FISHBURNE, VICE-PRES.
H. M. MAGIE, SECRETARY

OWNERS OF 2000
ACRES OF THE BEST
FRUIT LAND IN VIRGINIA

SHENANDOAH VALLEY APPLE LANDS CO., INC.
OFFICE: FIRST NATIONAL BANK BUILDING
WAYNESBORO, VIRGINIA

June 10, 1914.

Geo. Frank Lord, Mgr.,
Wilmington, Delaware.

Dear Sir:

File SF-328-GFL. Answering yours of the 5th.

The York Imperial apple trees shown in photograph sent you were planted in 1901.

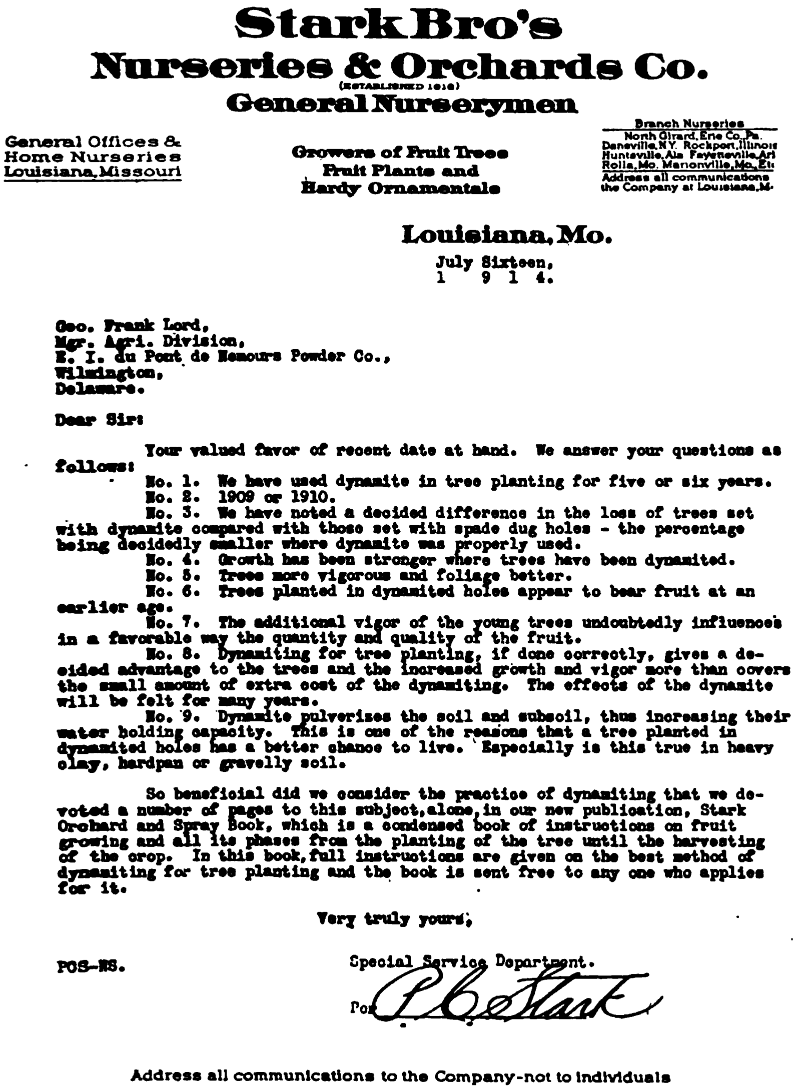
The spots shown in the photograph are lime sulphur spray which had been applied two days before the photograph was taken -- we are very proud that the spray shows up so uniformly on the fruit and foliage.

Please revise my answer #8 to read:- From a financial view point dynamiting tree holes costs from $6. to $8. an acre or $5. more than old methods but this additional cost is more than offset by the time saved in planting large acreage and this additional cost is recouped the first year in the extra growth and vigor of the young trees.

Yours truly,

H M Magie
Secretary.

HMM-K.



Stark Bro's
Nurseries & Orchards Co.
(ESTABLISHED 1816)
General Nurserymen

General Offices &
Home Nurseries
Louisiana, Missouri

Growers of Fruit Trees
Fruit Plants and
Hardy Ornamentals

Branch Nurseries
North Girard, Erie Co. Pa.
Dansville, N.Y. Rockport, Illinois
Huntsville, Ala. Fayetteville, Ark
Rolla, Mo. Manonville, Mo. Etc
Address all communications
the Company at Louisiana, Mo.

Louisiana, Mo.

July Sixteen,
1 9 1 4.

Geo. Frank Lord,
Mgr. Agri. Division,
E. I. du Pont de Nemours Powder Co.,
Wilmington,
Delaware.

Dear Sir:

Your valued favor of recent date at hand. We answer your questions as follows:

No. 1. We have used dynamite in tree planting for five or six years.

No. 2. 1909 or 1910.

No. 3. We have noted a decided difference in the loss of trees set with dynamite compared with those set with spade dug holes - the percentage being decidedly smaller where dynamite was properly used.

No. 4. Growth has been stronger where trees have been dynamited.

No. 5. Trees more vigorous and foliage better.

No. 6. Trees planted in dynamited holes appear to bear fruit at an earlier age.

No. 7. The additional vigor of the young trees undoubtedly influences in a favorable way the quantity and quality of the fruit.

No. 8. Dynamiting for tree planting, if done correctly, gives a decided advantage to the trees and the increased growth and vigor more than covers the small amount of extra cost of the dynamiting. The effects of the dynamite will be felt for many years.

No. 9. Dynamite pulverizes the soil and subsoil, thus increasing their water holding capacity. This is one of the reasons that a tree planted in dynamited holes has a better chance to live. Especially is this true in heavy clay, hardpan or gravelly soil.

So beneficial did we consider the practice of dynamiting that we devoted a number of pages to this subject, alone, in our new publication, Stark Orchard and Spray Book, which is a condensed book of instructions on fruit growing and all its phases from the planting of the tree until the harvesting of the crop. In this book, full instructions are given on the best method of dynamiting for tree planting and the book is sent free to any one who applies for it.

Very truly yours,

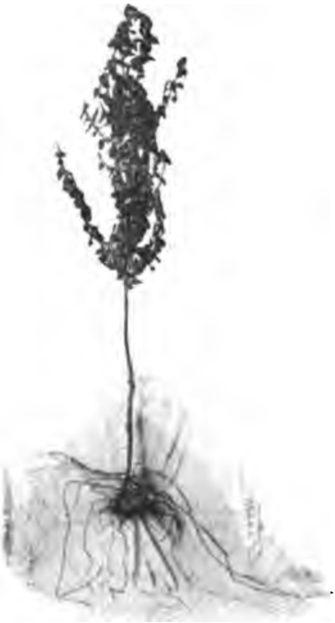
POS-MS.

Special Service Department.

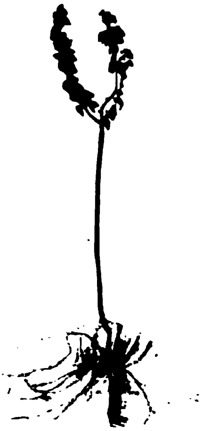
Per P. C. Stark

Address all communications to the Company-not to individuals

NOTE.—The book which Stark Bros. issue free to orchardists, entitled, "Stark Orchard and Spray Book," is well worth getting.



PLANTED WITH RED CROSS FARM POWDER.



PLANTED WITH SPADE.

PLANTED WITH RED CROSS FARM POWDER.

PLANTED WITH SPADE.

TWO-YEAR-OLD APPLE TREES (IN GROUND AND DUG OUT) ON FARM OF E. G. SEXTON, CANTON, GA.

Harrison Brothers Endorse Blasting

Harrison Brothers, with nurseries at Berlin, Maryland, have 4,000 acres, which contain more than 200,000 trees, and they are among the leading nurserymen of the East. They have prepared a very complete book entitled "How to Grow and Market Fruit," retailing at 50c. a copy, containing valuable information.

They say, "What is stated here is the most practical kind of hard-won knowledge, for it outlines 'how we do it' in fruit-culture."

From the chapter on "Methods of Keeping Moisture":

"Subsoiling with dynamite is a thoroughly practical method, and should be employed on three-fourths of the farms of the East.

"By far the best way to loosen subsoil is with dynamite. This is not generally known, but orchardists will find they can reduce tillage expenses greatly and save much time with it. The exploding of from a sixth to a half pound of the right kind, two or three feet under the surface, loosens and makes fine all the soil. Young trees will make great strides if they are so planted.

"The dynamiting can be done in orchards or about trees of *any age*. If done rightly, it will accomplish the work without breaking or tearing away any roots, leaving the soil in condition to give the roots twice the feeding-ground they had before and providing perfect drainage and water-storing capacity. The use of dynamite is the secret of success in growing fruit by mulching systems without so much plow and harrow tillage."

From the chapter on "Cultivation":

"It is necessary to break up the subsoil, whether there is hardpan or not. The dynamite method usually is the cheapest at any time, and it is the only way by which the work can be done thoroughly after trees have been planted.

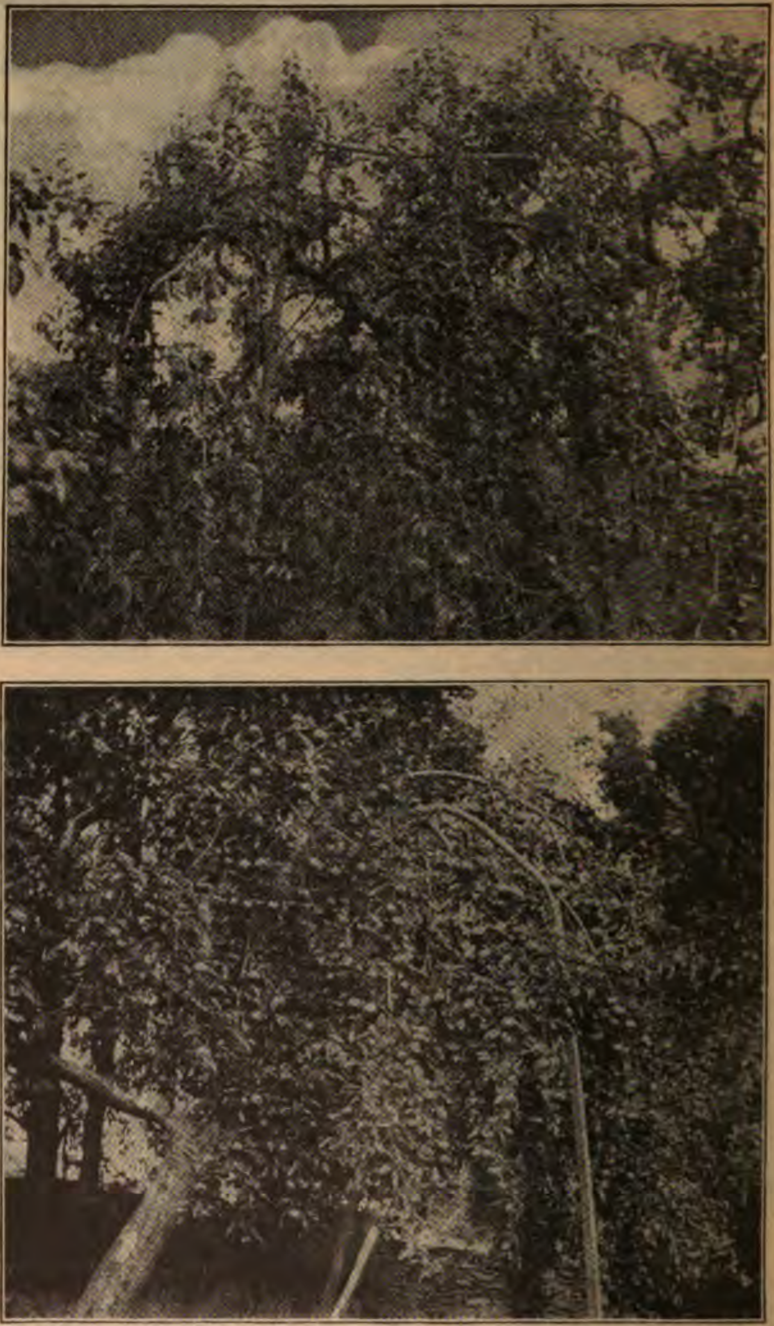
"Dynamite is the thing with which to dig holes for new trees, to break up the whole soil three or four feet deep every few years, and to help renovate old orchards, because it will do these things more cheaply and better than they can be done by any other means. If you have fruit trees, which seem to be standing still and which do not bear, no matter how big they are, properly explode a charge in the soil around or between them, and the trees will likely get to work. In a bearing orchard, a proper charge midway between trees is always safe and is generally very effective."

From the chapter on "When Trees Will Not Bear":

"Explode three or four charges of dynamite a few feet away from each tree. Mulch the surface with a thick covering of vegetable matter, or by keeping a couple inches of dust under the tree. Feed with commercial fertilizer."

From the chapter on "Grapes":

"Vines are heavy feeders. Their roots extend far out and make a network in the soil. The proper distance to plant will be from six to eight feet apart, although sometimes this can be changed to advantage. Strong varieties, on fertile soil, need more room than small growers on poor soil. Before planting is done, the ground should be worked even more thoroughly and deeply than for a tree. Remember that you are planting something which will last a generation, not a crop to be removed in a season or two. Plow the land, use dynamite to dig the holes, and have a clearance inside the hole of at least twenty inches."



APPLE TREES REJUVENATED WITH RED CROSS FARM POWDER ON FARM OF T. H. WATKINS, GLENBURN, PA. (See page 39)

Blasting Restores Failing Orchards

1. Young spade-set trees can be forwarded in development at least a year by blasting between the rows.

2. Old, failing trees can be restored to ample productiveness by blasting between the rows.

3. Fungus diseases can be eliminated by blasting under affected trees, or blowing out those killed by fungus, and planting new trees in their places.

We frequently receive letters from orchardists stating that they had planted trees in their orchards a year, two years or three years ago which are not doing well because of hardpan conditions beneath the surface soil or because of compacted soil or insufficient moisture storage capacity of soil. These orchardists express the keenest regret at having learned about tree planting with explosives after their orchards had been planted. They tell us they believe their trees would be in a much better condition had they been planted by this method.

If their trees are alive, the subsoil in which the trees are planted can still be broken up by subsoil blasting between the trees. This rejuvenation work will give the trees almost the same favorable opportunity for growth and development that they would have had had they been planted in blasted holes in the first place.

Millions of fruit, shade and ornamental trees are standing in the orchards, parks, yards and along highways in this country. Many of them are very valuable because of the fruit they are capable of producing. Others are highly prized by their owners because they serve to ornament and shade residence properties or parks; others add greatly to the appearance of streets.

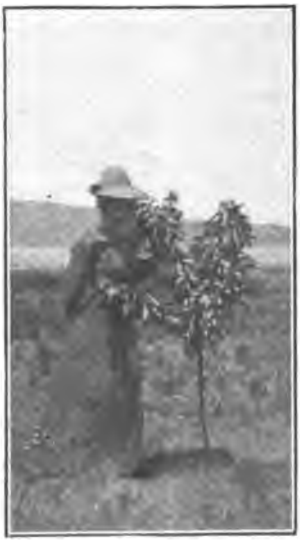
But many of these are in an unhealthy condition. If the soil in which the tree is planted is compacted so that it is difficult for the roots to make healthy growth into the deep subsoil or if the soil is not sufficiently porous to permit of the absorption and storage of moisture, blasting will prove an effective remedy.

In every part of the United States will be found trees in parks and along public highways showing signs of deterioration. Sometimes these conditions are due to the fact that the trees are planted in poor soil; sometimes because they are in soil underlaid with hardpan or compact subsoil; sometimes because their roots grow out under asphalt, cement or flag pavements which prevent them from obtaining the benefit of rain fall. In any of these cases the use of dynamite will improve the health of the tree.

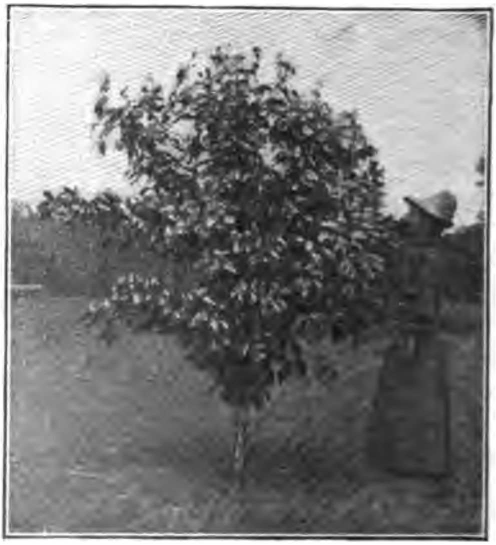
Blasting Pays Almost Anywhere

After having read the remarkable symposium of expert testimony in the preceding pages, there will still be doubting Thomases who will say: "Blasting might be a good thing in some states, but not in this state." While it is true there are some states where blasting is not as advantageous as in others, such as in Michigan, with its loose, sandy soils, and Iowa, with its deep prairie loams, we direct special attention to the Hale Georgia Orchard Co. letter covering their experience in sandy soil, and to the fact that the New Jersey Horticultural Department found blasting beneficial at the Vineland, N. J., Experiment Station, where the soil is sandy loam. It must be borne in mind that loose soils acquire plow soles, and also become diseased. Blasting breaks plow soles and kills by shock many inimical organisms in old orchard soils.

To prove the almost universal adaptability of blasting, we publish herewith brief extracts from letters in our files from all over the United States. No matter where you live there is some one within reasonable distance who knows from experience the benefits of blasting orchard soil. Therefore, if this booklet fails to convince you, we urge you to ask someone in your vicinity whose name and postoffice is printed herein. Don't plant any more trees until you settle this important question to your satisfaction. Out of every hundred who investigate blasting, we are confident ninety will adopt it. You cannot afford not to investigate!



BING CHERRY TREE, TWO YEARS OLD, SET IN SPADED HOLE IN 5-FT. OREGON LOAM.



BING CHERRY TREE, TWO YEARS OLD, SET IN DYNAMITED HOLE (Rawley letter, page 39)

OVERWHELMING NATIONAL EVIDENCE

ALABAMA

BLASTED TREES GREW TWICE AS FAST

CULLMAN. Planted orchard with Red Cross Farm Powder. In spite of dry weather, trees attained twice the growth over those in spade dug holes.

Ed. B. Miller, Supt.
Alabama Odd Fellows Home.

LOSS LESS THAN TWO PER CENT.

GREENVILLE. Planted 170 trees in blasted holes. Only two died. Trees in blasted holes are twice as far advanced as those in spade dug holes.

A. H. Vann,
Oak Lawn Farm.

BLASTED TREES LIVED; SPADE-PLANTED DIED

DOTHAN. Planted 10 Satsuma Orange trees with Red Cross Farm Powder and 10 without. Lost two planted in blasted holes and only had two to live in spade dug holes. Intend to plant all trees in the future with Red Cross Farm Powder.

E. R. Porter Co.

BENEFITS FAR IN EXCESS OF COST

CITRONELLE. Planted 1000 trees with Red Cross Farm Powder. Consider benefits far in excess of the cost and recommend its use to all who contemplate planting trees of any variety.

R. L. Scott, Sec'y and Treas.
Citronelle Nursery & Orchard Co.

HAD TO TRIM FAST GROWTH

FAIRHOPE. Trees set in blasted holes have grown so fast and large, they are top heavy. Had to trim branches.

C. L. Coleman.

REMARKABLE RESULTS

EVERGREEN. Used Red Cross Farm Powder in planting trees at Baptist Orphans Home. Results were so remarkable they ordered more trees planted in the same way.

T. H. Braswell.

ARKANSAS

EARLIER AND BETTER YIELD

FAYETTEVILLE. Planted 1100 peach trees with Red Cross Farm Powder. They made better growth than any trees in neighboring fields, bore earlier and fruit had better flavor.

I. W. Baxter,
Sam A. Clark & Co.

CALIFORNIA

GOOD RESULTS WITH ORANGES

FAIR OAKS. Planted 300 orange trees with Red Cross Farm Powder. Results very favorable. Expect to plant 30 acres more in the same way.

Percy S. Meaney.

FINDS IT ECONOMICAL

SACRAMENTO. Planted 200 acres of trees in blasted holes. Am convinced that the cost and percentage of loss can be materially reduced by the use of Red Cross Farm Powder. E. P. HILBORN,
Mission Olive Orchard Co.

ROCKY SUBSOIL CONQUERED

PENRYN. Planted trees with Red Cross Farm Powder where hard bed rock is very close to the top soil and found them to grow better than trees planted in spade dug holes. H. A. SNELLING,
Penryn Fruit Co.

HARDPAN EASILY SHATTERED

RIVERSIDE. Satisfied after the first work with Red Cross Farm Powder. Whatever the cost, it is money well spent. Hardpan is easily shattered by this method. Do not hesitate to use Red Cross Farm Powder for you can find nothing better. JAMES MILLER, Supt.,
Arlington Heights Fruit Co.

GAINED MORE THAN A YEAR

TUDOR. Planted 100 trees in blasted holes. They grew larger and faster than trees planted the year before in spade dug holes. Red Cross Farm Powder beats anything I ever saw for making trees grow fast. JAMES GRUBB.

ADOPTED AFTER EXPERIMENT

AZUSA. Planted 400 trees with Red Cross Farm Powder, after seeing good results obtained by a neighbor on three trees planted in blasted holes. Will plant more trees in the same way. THOS. A. SMITH.

MADE $15 LAND WORTH $200

DAVIS CREEK. Planted 14,000 fruit trees with Red Cross Farm Powder, and by its use have advanced the value of land from $15.00 per acre to $200.00 per-acre in less than a year. O. C. LANGFIELD.

REJUVENATED SICKLY TREES

SARATOGA. Planted a block of five trees in spade dug holes that did not grow. Afterwards used Red Cross Farm Powder; the trees showed vigorous growth at the end of first year. GUY U. SMITH, State Assemblyman.

THE TREES ARE THE BEST PROOFS

FLORIN. Planted row of trees in blasted holes. They speak for themselves and are a monument for all time. JAMES RUTTER.

A DECIDED SUCCESS WITH ORANGES

RIVERSIDE. The use of Red Cross Farm Powder in our orange orchard has been a decided success. GEO. ROUNTHWAITE.

DO YOU PREFER SCRUBS?

CARPENTERIA. Used Red Cross Farm Powder in planting 1000 trees. Trees planted in spade dug holes look like scrubs beside the ones planted in blasted holes. CHAS. L. LUNDY.

EXPERIMENT YIELDS PROOF

ORANGE. Used Red Cross Farm Powder in the center of some squares in my orange grove. The experiment confirmed my belief of long standing that many of our groves planted on the heavier soils would be much benefited by the intelligent use of Red Cross Farm Powder. C. J. K. JONES.

BEATS ANYTHING HE EVER SAW

PLACERVILLE. Blasted 19 tree holes with two sticks of Red Cross Farm Powder in each hole. Beats anything I have ever seen for digging out holes. Will plant no more trees in spade dug holes. RAY PHELPS.

MORE THAN REPAYS COST

FUSTIN. Planted 400 orange trees with Red Cross Farm Powder, which later proved to more than repay the extra cost in planting. PERRY LEWIS.

WATER STORAGE CAPACITY INCREASED

AUBURN. Planted trees with explosives with decided success. Blasting increases water storage capacity of the soil and trees will have more vigor and vitality, will grow faster, bear earlier and be more productive and longer lived.

J. A. Teagarden.

PULVERIZES HARDPAN

CORONA. Lemon trees on strip of orchard blasted last fall show a marked improvement in appearance. Intend treating all portions of orchard where conditions of trees indicate existence of a hard formation under them.

W. C. McCully, Mgr.,
El Cerrito Rancho.

SAVES IRRIGATION

RIVERSIDE. Found blasting saves one to two irrigations per year. Riverside Chamber of Commerce.

AN INTERESTING TEST

MARYSVILLE. Planted one tree in blasted hole and two acres of trees in spade dug holes. The tree in blasted hole made very good progress, while one-half of the other trees died. Was prompted to plant two more acres with Red Cross Farm Powder. Mr. E. E. Long.

YIELDS TREBLED BY BLASTING

SANTA ANA. Took 21 boxes of fruit from orange trees set in blasted hole and only seven from tree in spade dug hole. Find Red Cross Farm Powder to be a great labor saver. E. C. Frazen.

ONLY SUCCESSFUL METHOD

SAN DIEGO. Planted 20 acres of lemons with Red Cross Farm Powder. Find it to be the only successful method for planting trees.

W. R. Gunnis,
Pacific Wood & Coal Co.

PULVERIZES HARDPAN

STRATHMORE. Planted trees with Red Cross Farm Powder and feel confident that it was a great benefit, pulverizing the hardpan, and allowing the roots to penetrate same. The Strathmore Citrus Nurseries,
H. C. Van de Water, Mgr.

PLUMS GAIN A YEAR

DINUBA. Planted 600 plum trees in blasted holes. Have one year's growth over trees in spade dug holes. Would not blast without the use of Red Cross Farm Powder. Omega Ranch,
Z. M. Dickey, Mgr.

MARKED ADVANTAGE FROM BLASTING

WOODLAKE. Planted 600 acres of lemon and orange trees with Red Cross Farm Powder. Find a marked difference between the trees in blasted holes and the ones in spade dug holes. G. F. Stevenson,
Woodlake Orchard Co.

COLORADO

NURSERY HIGHLY RECOMMENDS BLASTING

LOVELAND. Used 2000 lbs. Red Cross Farm Powder in planting 10,000 trees. Results very satisfactory. We highly recommend its use in orchard planting. The Northern Colorado Nursery Co.,
M. R. Kilburn, Mgr.

FRUIT WON WORLD'S PRIZE

GOODPASTURE. Planted 300 trees with Red Cross Farm Powder. Only one-tenth of the cost of setting the same amount of trees in spade dug holes. Fruit from trees in blasted holes won World's Prize. Lee R. Roper.

GAINS A YEAR'S GROWTH

OXFORD. Trees planted with Red Cross Farm Powder have done finely. Had but little loss and trees are thriftier. Trees in blasted holes have one year's growth over those planted in spade dug holes. L. A. O'DONNELL.

INDUCES PHENOMENAL GROWTH

DENVER. Planted trees in cherry orchard with Red Cross Farm Powder. Growth of trees phenomenal. The loss about two per cent., due to poor stock. Trees were overheated in transportation. J. B. GEIJSBEEK.

STOPS FIRST YEAR LOSS

DENVER. Lost only nine trees out of 728 planted with Red Cross Farm Powder. Am convinced an additional advantage is obtained by its use. Would not consider planting any other way. F. W. GRAHAM.

INCREASED YIELD 60 PER CENT.

GRAND JUNCTION. I had 14 pear trees in my orchard that never produced over 71 boxes or five boxes to the tree. Since using Red Cross Farm Powder in this orchard, the trees have regularly produced 114 boxes or eight boxes to the tree. CHAS. P. SHEEHAN.

BLASTED TREES 50 PER CENT. BETTER

RIFLE. Trees planted in blasted holes are 50 per cent. better than those in spade dug holes. J. L. STEWART.

GREATLY REDUCED FIRST YEAR LOSSES

DENVER. Planted 70,000 fruit trees with Red Cross Farm Powder. Loss less than five per cent. In previous years the loss has been about 30 per cent. Growth of trees in blasted holes wonderful.

DENVER SUBURBAN HOME & WATER CO.,
H. R. Crane.

CONNECTICUT

REJUVENATES SIXTY-YEAR-OLD ORCHARD

STONINGTON. Used Red Cross Farm Powder to improve sixty-year old apple orchard which had borne nothing for several years. Have been much gratified at the results. Entire orchard loaded with apples and fruit much larger than usual. EUGENE P. EDWARDS.

BLASTED TREES THRIVE ON POOR LAND

MANCHESTER. Planted fruit trees on rocky hillside, using Red Cross Farm Powder to dig the holes. Trees are growing and coming on good.

C. R. BURR & CO.

CHEAPER AND BETTER THAN SPADE PLANTING

NORWICH. For the past three years, have used explosives with great success in planting my young trees. It not only does the work better but cheaper than digging holes by hand. THE KITEMAUG ORCHARD CO.,
F. W. Browning, President.

RECOMMENDS BLASTING FOR REJUVENATION

GLASTONBURY. On account of successful results from blasting Hale Georgia Orchard Co. peach orchards in Georgia recommends blasting old New England apple orchards to rejuvenate them. J. H. HALE.

DELAWARE

REGRETS ALL TREES WERE NOT BLASTED

COOCH'S BRIDGE. My experimental plots of trees in blasted ground showed such increased growth over those planted with spade, I regret all were not blasted. L. H. COOCH, Farm Adviser, Delaware Experiment Station.

DISTRICT OF COLUMBIA

EX-SECRETARY MOORE EXPECTS TO GAIN TWO YEARS

WASHINGTON. Planted 35 acres of trees with Red Cross Farm Powder. Am of the opinion they will make five years' growth in three years.

Willis L. Moore,
Ex-Sec'y U. S. Dept. of Agriculture.

FLORIDA

QUICK RESULTS FROM REJUVENATION

FT. MYERS. Blasted my grape fruit grove of 350 trees about a month ago. Trees are putting on a beautiful new growth. I consider it worth $1000 more than before I used explosives. H. O. Banister.

ENSURES THRIFTY TREES

HOLDER. Planted citrus grove in blasted holes during February, 1913. Result, fine crowns, very thrifty trees. Henry G. Bystra.

EXCELLENT RESULTS IN FLAGLER GROVE

MIAMI. Red Cross Farm Powder proved extremely satisfactory and most inexpensive in rejuvenating 8000 grape fruit trees in the Kendal Grove owned by Mr. H. M. Flagler. This (1911) is the first year the Kendal Grove has borne any crop of consequence, the yield amounting to 4300 boxes which is excellent considering the age of the grove.

J. E. Ingraham,
Supervisor Kendal Grove,
Vice-Pres. Florida East Coast Railway.

GEORGIA

GAINS TWO YEARS WITH PECANS

COLUMBUS. Used Red Cross Farm Powder in planting pecan trees. Trees in blasted holes are about three times as large as those in spade dug holes and came into bearing two years earlier. F. W. McMurrain.

100 *VS.* 58

AUGUSTA. Sold a customer sufficient explosives to plant 100 trees. At the same time, his neighbor planted 100 trees using the old way of digging. Neighbor has 58 trees living while our customer did not lose a single tree.

Lamb & Hollingsworth.

BLASTED TREES GROW ONE-THIRD BETTER

FORT VALLEY. Trees planted in blasted section of orchard have a growth of 33⅓ per cent. more than the unblasted section. Leaves have a much better color and trees are standing dry weather better than the unblasted trees.

Duke Brothers.

THE FINEST HE EVER SAW

FRANKLIN. Trees I planted two years ago with Red Cross Farm Powder are the finest trees I ever saw. My business is selling fruit trees. If you will send me a supply of your booklets, I will hand them out to all of my customers. I would like to see them all plant their trees in blasted holes.

George Alexander.

SPLENDID RESULTS WITH PECANS

MILLEDGEVILLE. Planted 1500 pecan trees with Red Cross Farm Powder. Obtained splendid results. Trees have shown vigorous growth and bore nuts sooner than they otherwise would have done. Edward & Patterson.

GAINED TWO YEARS

MAYFIELD. Planted peach trees with Red Cross Farm Powder. These trees will bear as much fruit at four years old as they would at six without the use of explosives. W. W. Stevens.

FIRST YEAR LOSS ALMOST NOTHING

CHAMBLEE. Out of 3000 trees planted with Red Cross Farm Powder only two have died. Trees in blasted holes are very much larger than those in unblasted holes. A. E. Cole.

WHY BLASTING REJUVENATES

BACONTON. Will recommend Red Cross Farm Powder highly for use under old trees as it leaves the ground in a soft and porous condition enabling the roots to take advantage of the moisture and available plant foods.

Barnwell Pecan Orchards Co.

FINE FOR PECANS

DE WITT. Mr. Bacon told a Du Pont Salesman that blasting had been employed experimentally in tree planting in 1912 on the pecan properties owned by his company; that the trees in the blasted holes did much better than other trees on the same plot; that in future planting work, they intended using explosives.

G. M. Bacon Pecan Co., Inc.

IDAHO

GROWTH OF TREES MARVELOUS

BOISE. In the Fall of 1912, used Du Pont explosives to break up hardpan and subsoil in my orchard. Trees were planted the following Spring and given the usual cultivation. Gave the orchard a light irrigation the first of July and did not irrigate again that season. Growth of trees marvelous. T. A. Johnson.

ILLINOIS

MORE THAN PLEASED

NAPERVILLE. Planted 350 trees in blasted holes. We are more than pleased with the results obtained and thoroughly recommend the use of Red Cross Farm Powder. F. W. Von Oven, Mgr. The Naperville Nurseries.

INDIANA

GROW RIGHT THROUGH DROUGHT

NEW ALBANY. Planted 4000 trees with Red Cross Farm Powder. Loss of trees will not exceed five percent. although we have had a six weeks' drought.

Newton A. Greene, Mayor.

CHEAPER TO BLAST THAN DIG

COLUMBIA CITY. Planted 200 fruit trees with Red Cross Farm Powder. At the same time, planted 18 trees in spade dug holes and they cost me twice as much per tree as planting with explosives. Arthur E. Hancock.

KANSAS

BLASTED TREES BEAR FRUIT EARLY

COLUMBUS. Planted three peach trees in blasted holes and six in spade dug holes in the same ground. Three years later, trees in blasted holes were stronger and healthier and produced from five to six bushels of very fine peaches. Trees planted in unblasted holes bore practically no peaches, both fruit and leaves having shriveled up and dropped off during dry season.

W. R. MacDonald.

KENTUCKY

GAINED A YEAR WITH APPLES

MILBURN. Planted 100 apple trees with Red Cross Farm Powder. They produced fruit one year earlier than those in spade dug holes.

D. P. SANFORD.

LOUISIANA

100 PER CENT. *VS.* 20 PER CENT.

COVINGTON. Planted a number of trees with spade and not 20 per cent. grew. Planted in blasted holes and every one of them grew. Would not think of planting trees without Red Cross Farm Powder. G. C. ALEXIUS.

STOPS FIRST YEAR LOSS

SHREVEPORT. Used Red Cross Farm Powder for planting 1080 pecan trees. Planted 8000 peach trees without. The percentage lost on the pecan trees was almost nothing compared to the loss of peach trees during the dry spell.

S. H. BOLINGER,
Clear Creek Lbr. Co.

MAINE

BEYOND COMPARISON

AUBURN. Have not seen or heard of trees to come up to our young orchards that were planted with Red Cross Farm Powder.

HOMER N. CHASE & Co.

MARYLAND

EASY TO PLANT IN BLASTED GROUND

BALTIMORE. Planted 40 fruit trees with Red Cross Farm Powder and was very much pleased with the easy way of working it.

CHAS. FEHRMANN & Co.

FRUIT TWICE AS GOOD

SNOW HILL. Planted pear and plum trees with Red Cross Farm Powder. Trees in blasted holes brought $2.00 per bushel. Fruit from trees in spade dug holes only brought $1.00 to $1.25 per bushel. T. J. SELDER.

MASSACHUSETTS

MARSHFIELD. Planted 80 apple and cherry trees in blasted holes and 20 in spade dug holes. Only three of the trees planted in blasted holes died; whereas, 12 of those planted in dug holes died. Had never used dynamite before doing this work, but had no trouble in following the instructions.

CHAS. P. DUFFIE, JR.

OTHER METHODS ARE OBSOLETE

SPRINGFIELD. In spite of a drought which set in immediately after I had planted 264 trees with Red Cross Farm Powder, every tree lived. Planting trees without Red Cross Farm Powder is obsolete, wasteful of time and money. I cannot afford to plant without it. V. J. IRWIN, M. D.

MADE SPLENDID GROWTH

BOSTON. Planted 1500 trees with Red Cross Farm Powder. They made splendid growth. Will plant more in the same way. FRANK I. COOPER.

GETS APPLES IN ONE YEAR

BOSTON. Planted 15 trees with Red Cross Farm Powder. One tree out of the 15, not more than one-half or three-quarters of an inch in diameter, had two large, perfect apples at the end of the first year. Consider this to be a most remarkable circumstance. F. S. Hill.

MICHIGAN

SOUTH HAVEN. Used dynamite to pulverize soil between trees in orchard, with splendid success. Chas. E. Abell.

GRAND LEDGE. Blaster Duzenberry reports his best advertisement is an orchard of 1200 trees set in blasted ground for Mr. Gordinere, everyone of which lived and developed nicely.

MINNESOTA

CHEAPER AND QUICKER

VIRGINIA. In future the Park Board of Virginia will use Red Cross Farm Powder for tree planting as the work can be done cheaper by this method and also quicker, especially when labor is scarce.

Arthur A. Beischjold,
Supt. of Parks.

ANOTHER CONVERT

LAWLER. I considered it all a fake to plant trees with explosives until it was proved to me last Fall that it not only paid well, but no one can afford to use the shovel for digging fruit tree holes. V. Carlson, Proprietor,
Lakeview Nursery.

MISSISSIPPI

FINE FOR PECANS

OCEAN SPRINGS. Cannot conceive of any other method that will put the ground in as satisfactory condition for root-system.

Ocean Springs Pecan Nursery.

MISSOURI

BY FAR BETTER

BRANDSVILLE. Planted 240 acres of trees with Red Cross Farm Powder. They are by far better than any raised in spade dug holes.

J. F. Shoemaker.

REDUCES LABOR ITEM TO MINIMUM

MELVA. Have used Red Cross Farm Powder in planting fruit trees with good results. The labor item was reduced to a minimum. Shots shattered hardpan and left soil mellow and friable.

Herbert T. Wiltse, Mgr.
The Ridgedale Orchards Co., Inc.

METHOD CAN'T BE BEAT

WEBB CITY. Although last Spring and Summer were the worst in years, not one of the trees planted in blasted holes died. For inexpensiveness and satisfactory results, the explosives method can't be beat.

W. R. Robertson, Lawyer.

MAKES TREES GROW IN TOUGH SOIL

JOPLIN. Set out 823 trees in McClelland Park and on the Boulevard by shooting the holes with Red Cross Farm Powder. Soil was flint and hard clay. All lived except 14. We attribute this remarkable record to the use of explosives.

M. F. Keith,
Supt. of Parks.

SAVED 60 PER CENT. IN DROUGHT

APPLETON CITY. Set out 700 trees with Red Cross Farm Powder last Spring and then had the worst drought in 10 years. Was surprised to find that 60 per cent. of our trees thrived; without explosives all would have died.

Burt Cline.

REJUVENATION SUCCEEDS

WEBB CITY. Planted one acre to peach trees in 1907 without explosives. Lost all but 50 trees. Growth of those living did not exceed 15 inches. In 1910, used Red Cross Farm Powder to rejuvenate remaining trees. In spite of unfavorable weather, I lost no trees and growth was from 18 to 40 inches in one season.

M. S. Williams.

FULLY CONVINCED

KANSAS CITY. I am an earnest apostle of the use of dynamite in tree planting.

S. G. Warner, G. P. A.,
Kansas City Southern Railway Co.

TWICE AS BIG IN SIX YEARS

ST. JAMES. Norwegian maple planted at roadside in six years grew sixteen feet against eight feet of spade set tree.

J. F. Burge.

MONTANA

MADE MUCH BETTER GROWTH

DARBY. Planted 40,000 trees in blasted holes. Trees made a much greater growth than those planted one year before where Red Cross Farm Powder was not used.

W. I. Moody,
Como Orchard-Land Co.

A GREAT TIME AND LABOR SAVER

HAMILTON. Planted 36,000 apple and cheery trees with Red Cross Farm Powder, and found it to be a great time and labor saver.

Walter E. Long.

NEBRASKA

GOOD FOR LARGE TREES

BENSON. I find that dynamite is a good help even in planting large trees.

R. Timmler,
Landscape Gardner and Nurseryman.

MORE, BETTER, AND QUICKER FRUIT

ALLIANCE. Trees planted with Red Cross Farm Powder have made a wonderful showing and my customers are getting full returns in the way of more fruit, better fruit and quicker fruit. Holes cannot be dug in the hard soil in this district with a spade for twice the cost of the explosives.

J. P. Barger, Prop.
Alliance Nursery.

NEW JERSEY

FINDS BLASTING OF VALUE IN GRAVELLY LOAM

VINELAND. New Jersey Horticultural Society Proceedings for 1912 reports that peaches set in loose gravelly loam at the Vineland Experiment Station showed considerable gain in growth over trees set by ordinary method.

ALL OF 1200 LIVED

MIDDLEBUSH. Of my 1200 trees set with dynamite all lived and are fine specimens. Of 50 trees planted by a neighbor with spade in next lot 49 trees died.

NEW MEXICO

A COLLEGE ENDORSEMENT

STATE COLLEGE. From Press Bulletin No. 243 N. M. College of Agriculture and Mechanic Arts: "In heavy adobe soils it has been found advantageous to explode small charges of 20 per cent. dynamite, 18 to 36 inches beneath the surface to form a hole for the tree, at the same time loosening the soil to a greater extent, both in surface area and depth, than is possible when holes are spaded."

Roland Harwell,
Assistant in Agronomy.

NEW YORK

GETS PLEASING RESULTS

ROCHESTER. Formerly a partner in the Hooker Wyman & Company Nursery. Now a nursery broker. Own a 10 acre orchard which was planted in blasted holes. Am well pleased with its progress. W. W. Wyman.

EDITOR ENDORSES METHOD

ROCHESTER. Believe in and advocate use of explosives for planting trees.
Elmer E. Reynolds, Editor of *Rural Life*.

WHY BLASTED TREES THRIVE

MIDDLE GRANVILLE. Planted 500 trees in blasted holes. Will never again entertain the thought of setting trees in the old way. Trees set in blasted holes have by far the advantage over trees set the old way as the subsoil is so shattered that the roots find it easy to shoot out and find the necessary plant food.

Hicks Bros.

FAST WORK

TOWNES. Planted 7200 trees in blasted holes in 1440 hours. Average number planted per day was 720. This would have been impossible without the assistance of dynamite. C. W. Kimball.

A TIP FOR NURSERYMEN

ONEONTA. Used explosives in preparing seed beds. The following year, seedlings were taken out to see whether they were stronger or healthier than other trees planted at the same time on unblasted land. Tap roots of young seedling trees on blasted ground fully 15 inches longer than those on unblasted plots.

Mr. June, Supt. of Nurseries,
Delaware & Hudson R. R.

A GREAT SUCCESS

BINGHAMTON. Planted 150 trees with Red Cross Farm Powder and same was a great success. L. J. English.

GAINED ONE-THIRD IN A YEAR AND A HALF

YOUNGSTOWN. Trees planted in blasted holes made 1/3 better growth, in a year and a half than those planted in spade dug holes. Henry Lutts.

MAKES STURDIER TREES

HOLLEY. Planted 50 fruit trees in blasted holes. They are much better matured and sturdier than those in spade dug holes.

SETH A. ALLIS & SON.

MADE WONDERFUL HEADWAY

NEW YORK CITY. Apple trees planted with Red Cross Farm Powder have made wonderful headway. W. S. MYGRANT.

GAINED A YEAR'S GROWTH

MILTON. Four hundred trees planted in blasted holes have made a year's growth over those in spade dug holes. J. R. CLARKE & SON.

ENTIRELY SATISFACTORY

OAKFIELD. Mr. J. W. Drake, of Elba, N. Y., has finished a job of tree-planting with Red Cross Farm Powder to my entire satisfaction.

C. D. ROBERTS.

CONVINCED

ROXBURY. Was pursuaded to use Red Cross Farm Powder for planting an orchard of 10 to 12 acres, and am convinced of its benefit.

FRANK P. WILSON.

NORTH CAROLINA

NEVER AGAIN WITHOUT BLASTING

TYRON. Used Red Cross Farm Powder to set out 4600 grapevines, two acres of apple trees and two acres of peach trees. Vines and trees have done remarkably well. Will never plant vines or fruit trees in any other way.

BELLA VISTA FRUIT & POULTRY FARM,
B. C. von Kahlden, Prop.

TREES GREW FINE

REDDIES RIVER. Planted 6000 trees with Red Cross Farm Powder and they grew fine. Blasting is the only method of digging holes for trees, as it breaks the earth all around them. W. J. PALMER.

DID VERY EFFECTIVE WORK

NORTH WILKESBORO. The Red Cross Farm Powder I used to plant 500 peach and apples trees did very effective work and gave them a permanent growth that could not be gotten any other way.

H. W. HORTON, Sec'y and Treas.
Citizens' Loan & Trust Co.

SURPRISING GROWTH

OAKWOODS. Planted 1000 apple and peach trees with Red Cross Farm Powder in 1913. Growth of young trees surprising. GOLD MEDAL ORCHARDS.

CONVINCED

DAVIDSON. Am so convinced of the value of planting trees with Red Cross Farm Powder that I have planted 1500 in this way and expect to plant all the rest that way.

HENRY LOUIS SMITH,
Brushy Mountain Orchards Co.

WITHSTAND DROUTH

CHARLOTTE. Fruit trees planted on my farm with Red Cross Farm Powder are withstanding the drought much better than those planted otherwise.

JAS. O. GARDNER.

LIKES THE METHODS

WAYNESVILLE. Set apple trees in blasted holes. Like the method very much. R. N. BARBER.

OHIO

SOLVES REPLACEMENT PROBLEM

GYPSUM. Used explosives to remove dead trees and to re-plant new trees in place of them. Opening up and aerating the soil and the destruction of insect life by blasting solved the difficult problem of making a young tree grow where an old one had been removed.
WM. MILLER & SON,
Elmwood Fruit Farm.

SAVES DYING TREES

ELYRIA. Many an old tree along sidewalks have I saved by exploding small charges below the root system, tamping them in with fertilizer.
M. J. WALTERS.

REDUCES COST

YOUNGSTOWN. After planting trees in City Park with Red Cross Farm Powder, am convinced it is the only way to plant trees and shrubs. It reduces the cost materially and promotes better growth.
LIONEL EVANS, Supt. of Parks,
Board of Park Commissioners.

GAINED TWO YEARS

CLEVELAND. Saved fully 15 per cent. by planting 7000 trees with Red Cross Farm Powder. They made a better showing than trees planted two years before in the same soil with spade.
GEO H. BURROWS,
The Geo. H. Burrows Dev. Co.

SPLENDID RESULTS

ST. CLAIRSVILLE. Used Red Cross Farm Powder in planting orchard trees. Had such splendid results, expect to plant from 500 to 1000 more in the same way.
J. W. RILEY,
The Riley Fruit Farm.

WOULD NOT CONSIDER ANY OTHER WAY

MACEDONIA. Planted 4000 trees in blasted holes, and have as fine orchard as could be desired. Would not consider planting trees any other way.
ROY S. OSBORN.

MORE VIGOROUS GROWTH

CLEVELAND. Planted 3000 trees with Red Cross Farm Powder. They have made quicker and more vigorous growth than trees in spade dug holes.
J. M. HILBISH, Mgr.
The Lake Erie Apple Orchards.

THE ONLY WAY

TACOMA. Planted 25 trees with Red Cross Farm Powder and 15 in spade dug holes. Lost one in blasted holes and just two lived in spade dug holes. Fully convinced that the only way to plant trees is with Red Cross Farm Powder.
T. W. BRANSON, Supt.
Belmont County Children's Home.

ALL FLOURISH

JEFFERSON. Planted about 50 trees with Red Cross Farm Powder. All in flourishing condition.
CHAS. R. SARGENT, Sec'y
The Ashtabula Co. Agricultural Society.

RESULTS FAVORABLE

PIQUA. Planted 200 fruit trees with Red Cross Farm Powder. Results very favorable.
A. J. SCHNEYER.

RESULTS BEYOND EXPECTATIONS

NELSONVILLE. Planted 800 trees with Red Cross Farm Powder. Results were beyond my expectations. Am convinced that it is the only way to prepare soil for planting trees, and expect to plant 5000 more apple trees in the same way.
C. S. TEDROW, Land Agent
New York Coal Co.

MADE WONDERFUL GROWTH

WARRENVILLE. Planted 10 acres of apple orchard with Red Cross Farm Powder and 10 acres without. The trees set in blasted holes made wonderful growth with less than two per cent. lost. Trees set without Red Cross Farm Powder had at least 15 per cent. dead trees.

G. J. Wilder, Mgr.
B. of Sci. Agric, Cooley Farms.

THOROUGH AND SURE

NEWARK. The only way to plant trees is with Red Cross Farm Powder. It is thorough, quick, economical and sure. John P. Camp.

OKLAHOMA

SUPERIOR FRUIT

BLACKWELL. Used Red Cross Farm Powder in planting 2500 trees. Fruit is much superior to those in spade dug holes. J. W. Tetirick.

GROWTH DOUBLED

LONE GROVE. Trees planted in blasted holes, at the end of the first season were nearly twice as large as those planted in spade dug holes.

C. C. Rittenhouse.

OREGON

COST HALF AS MUCH

PORTLAND. Trees planted in blasted holes show marked improvement over those planted by spade. Blasted holes cost just one-half as much as spade dug holes.

Irving Worthington, C. E.
Rogue River Valley Canal Co.

MONEY WELL SPENT

GRANTS PASS. Planted 3000 trees in blasted holes. Found that Red Cross Farm Powder is money well spent in orchard planting on any kind of land.

Tokay Heights Development Co.

MORE AND BETTER FRUIT

MEDFORD. Orchard rejuvenated by blasting between trees yield more and better fruit. J. H. Neustadt, Owner Liberty Orchards.

BLASTS EVERY TREE HOLE

GRANTS PASS. Thirty acres of new orchard and every tree set with Red Cross Farm Powder. Would not undertake to clear ground or set new trees, shade or orchard, without using it. Mrs. John Rawley.

PENNSYLVANIA

CAN'T BE BEAT

POTTSTOWN. Have used explosives for 15 years on my two farms. For planting trees, Red Cross Farm Powder can't be beat. Blasted trees are finest in the orchard. Would not plant a tree without explosives and heartily recommend their use as a labor saver.

J. C. Saylor,
Cedar Grove Fruit Farm.

INCREASED YIELDS

GLENBURN. Used Red Cross Farm Powder to rejuvenate my apple orchard. Yields materially larger. Got 211 bushels the first year and 537 bushels the second year from 56 trees—all strictly first grade handpicked apples.

C. E. McCormick, Mgr.
Red Top Farm.

97 PER CENT. SUCCEED

BALLY. Planted 700 apple and 100 peach trees using Red Cross Farm Powder to dig the holes. Am very well pleased with results. Although trees were in bad condition when planted, 97 per cent. have made splendid growth.

Geo. W. Melcher.

THE EASIEST WAY

WAYNESBORO. Planted 1100 cherry trees by the use of Red Cross Farm Powder. Find it a very easy way as the holes are so easy to shovel out and deep enough to put in plenty of good rich soil.. A. D. Morganthaler.

PHENOMENAL GROWTH

FOXBURG. Planted over 2800 trees, using Red Cross Farm Powder. The growth of trees was phenomenal. To have dug the holes large enough to accommodate the roots of trees would have cost us much more than the explosives method. Harvey Brothers Orchards.

By F. L. Harvey.

RESULTS FAVORABLE

ERIE. Set out 62 fruit and 100 shade trees with Red Cross Farm Powder and results were entirely favorable. C. D. Hayes.

DECIDED DIFFERENCE

AVONIA. Setting out three acres of trees with explosives. Very decided difference in the growth of those in blasted holes as compared with those in spade dug holes. Expense of explosives method only amounted to about 50 per cent. of hand method. R. J. Holliday, Mgr.

Idlewood Poultry Farm.

MUCH PLEASED

CANTON. Entire orchard of 2644 trees was planted with Red Cross Farm Powder at an average cost per tree of about 11½ cents, including labor for rock drilling and removing old stumps. Am very much pleased with result.

L. M. Marole,
With Belmar Manufacturing Co.

SURPRISING RESULTS

EXTON. Planted 300 fruit trees with Red Cross Farm Powder. Result was surprising and pleasing. Only one tree had died, the others doing exceptionally well. Neighbor who planted without explosives lost four out of five; another planted 300 and lost half of them. Richard H. Trimble.

GREAT ECONOMY

NORTH EAST. Used explosives for tree planting very satisfactorily. Has proved not only a great economy in labor but the work was done better and trees invariably made better growth. Crawford Brothers Co.

DROUGHT INSURANCE

MEADVILLE. Planted a number of fruit trees in blasted holes at a cost of seven to eight cents per tree. These trees withstood the drought much better than those planted in spade dug holes. W. S. Wise.

SAVES TIME IN PLANTING TREES

PHILADELPHIA. Planted 100 peach trees in blasted holes in one day. Ground is now very loose. Am more than pleased with results and would not plant another tree on my place without explosives. A. F. Bornot Bro. Co.

BETTER AND QUICKER

MT. ALTON. Used Red Cross Farm Powder to plant 400 trees and find it better and quicker than any other way. R. J. Gates.

VERY SATISFACTORY

ALTOONA. Results obtained from the use of Red Cross Farm Powder in planting trees in City Parks were very satisfactory. Members of Park Board think it is the only practical way of doing tree planting.

E. Engelmann,
Member of Park Board.

REMARKABLE GROWTH

WASHINGTON. Planted 1600 fruit trees with Red Cross Farm Powder. Trees are making remarkable growth and we are entirely satisfied that planting with explosives is a thoroughly practical method.

GEO. H. WARRICK, Manager Washington Floral Co.

REDUCED COST

WARREN. Planted 1000 trees with Red Cross Farm Powder. Trees are much stronger and larger than those in spade dug holes. Use of explosives considerably reduced cost of planting. Loss of trees in spade dug holes 16⅔ per cent. while in the blasted holes loss was about one per cent. ALEX. L. SHAW.

BEST AND CHEAPEST

ALTOONA. Am thoroughly convinced that the explosives method of tree planting is the best and the cheapest as the soil is broken up sufficiently to permit the natural growth of the tree. EMIL ENGELMANN,

Florist and Landscape Gardner, With P. R. R. Co.

NURSERYMEN PUSH IT

LIBRARY. Had such good results we urge everyone to try blasting.

PITTSBURGH NURSERY CO.

SOUTH CAROLINA

REPLANTS GROW FAST

MERIWETHER. Considered replanting of peach trees in old orchards impractical until I began using dynamite. Now replanting with great success, using explosives, and the trees are making as much growth in a year as they did in the old way in two or three years.

LOCUST HILL ORCHARDS, Wm. S. Middleton.

SOUTH DAKOTA

REMARKABLE RESULTS

MITCHELL. Planted 50 trees in blasted holes on a high point where there is considerable gravel and the soil hard. The results were so remarkable that the City Park Board expects to blow 400 holes with Red Cross Farm Powder.

H. D. VAN BENTHUYSEN, School of Commerce.

WONDERFUL GROWTH

WYMORE. Planted 100, one year old, apple trees in the Spring with Red Cross Farm Powder that were cut off 18 inches above the ground. By late Fall they were as high as an average man's head, having made wonderful growth for yearly trees. L. BRIDENTHAL & Co.

TENNESSEE

RECOMMEND METHOD

SMITHVILLE. W. H. Davis & Son, wholesale nurserymen, frequently send us names and addresses of their customers and ask us to send them Farmers' Handbooks to give them proper instructions for blasting tree holes. Davis & Son recommend this method to their customers.

MUCH MORE SATISFACTORY

JOHNSON CITY. Planted 2500 trees with Red Cross Farm Powder and a few in dug holes as a check. Those in blasted holes made a much more satisfactory growth than those planted by spade. Expect to plant 8000 more trees with Red Cross Farm Powder. R. F. BREWER, Industrial Agt.

Carolina, Clinchfield and Ohio R. R. of South Carolina.

TEXAS

DROUTH PROOF

NEW BRAUNFELS. Planted 40 trees with Red Cross Farm Powder. In spite of great drought during Summer, trees in blasted holes stood green all Summer and did not stop growing at all, while those in dug holes stopped growing and suffered much from drought. Otto Locke, Proprietor
Comal Springs Nursery.

VERY SUCCESSFUL

HOUSTON. Our success with explosives in planting trees has been so satisfactory that we would not think of planting trees, particularly pecans, without first blasting the holes F. W. Colby, President Aldine Fig Co.

KILLS FUNGUS

BROWNWOOD. Exploded charge of Red Cross Farm Powder in spot of ground infested with root rot fungus. Immediately planted a cherry tree in same spot which grew well without any signs of root rot. Believe explosion will destroy this disease within considerable distance of center of explosion.
Chas. F. Ward, Mgr. Arbor Hill Nurseries.

DOING NICELY

LAREDO. Have started a park in this city known as "Bella Vista Park" and all the trees were planted by dynamite and they sure are doing nicely.
E. O. Staben.

VERMONT

A LIFE INSURANCE POLICY

SANDGATE. Soil sandy loam. Blaster, as a test, shot 250 holes in 40 minutes. Cost of labor, explosives, etc., .0309 per hole. Consider planting trees in blasted holes giving them a life insurance policy.
Geo. W. Dennehy, Mgr.
Egg Mountain Orchards.

VIRGINIA

TREES DO BETTER

LYNCHBURG. Have used Red Cross Farm Powder for tree planting and find that the trees do a good deal better when the holes are so prepared.
M. N. Moorman, Jr.

BLASTED TREES SEVENTEEN YEARS

LYNCHBURG. Have been planting trees with dynamite for seventeen years with success. R. C. Driver. Supt. Park Commission.

SPEEDS UP GROWTH

CHERRYDALE. Used Red Cross Farm Powder for planting young trees and rejuvenating old ones. Trees planted in this manner are running away from the rest while those cultivated with Farm Powder show marked improvement over those worked in the old way. Paul C. Bischoff.

NEVER AGAIN FOR SPADE

CROZET. Am using Red Cross Farm Powder every day now. Bought 250 lbs. to plant 1000 trees. Find it O. K. Shall never dig another hole for trees except with Farm Powder. S. K. Garrison.

DID FINE WORK

STEVENSBURG. Used Red Cross Farm Powder to set out 600 trees and it did fine work. H. McVeigh.

COST LESS

RICHMOND. Planted 100 trees with Red Cross Farm Powder in 1911. Did not lose a tree, although Summer of 1912 was very dry. Trees made vigorous growth. Explosives cost less than labor or digging holes for old-style tree planting. R. H. Johnson.

ALL LIVED

WAYNESBORO. Planted 30 trees with Red Cross Farm Powder in April, 1911. Although Summer was very dry, all have lived and done well. Balance of the orchard set out in the old way did very poorly and only a few trees lived.

W. R. Booker.

PHENOMENAL RESULTS

STUARTS DRAFT. Trees are far outstripping neighbors' trees planted without Red Cross Farm Powder. I set 300 apple and 900 peach trees in the Fall of 1911. Blasted every hole. Results were phenomenal as in 1913 all of the 1200 trees set are living and thriving. R. B. Nugent.

MORE THAN PLEASED

CHARLOTTESVILLE. Planted my orchard in 1911 with Red Cross Farm Powder. Orchard has done finely and am more than pleased with results.

Thos. S. Keller.

WONDERFUL GROWTH

TIMBERVILLE. In November, 1912, had dug about 8000 tree holes and had 16,000 more to dig. Was induced to try Red Cross Farm Powder on remainder. While next year was very dry, trees did not suffer and made wonderful growth as a result of blasting. J. T. Kelley.

FAR AHEAD OF OLD METHOD

ROANOKE. Used Red Cross Farm Powder in planting fruit trees. Consider it far ahead of old method, getting quicker and better results.

Ernest B. Fishburn.

A GREAT BENEFIT

MONTROSS. The apple trees regenerated with Red Cross Farm Powder last year are in splendid condition and full of fruit. As 1912 was a dry year, blasting was a great benefit. A. E. Carver.

DROUTH PROOF

FISHERSVILLE. Used Red Cross Farm Powder to set out young trees in our orchard. The practical and beneficial result of the experiment was that while the drought was distressing in the balance of the land, from two to three feet from the trunks of our small trees in blasted ground was distinctly damp.

Wm. A. Pratt, Mgr. Bell View Orchard Co., Inc.

CONCLUSIVE PROOF

TIMBERVILLE. Trees planted in spade dug holes in my three-acre orchard failed to grow and I kept resetting them each year for three years. In every instance, tree died before they had made four inches of growth. The fourth time I used explosives to set trees. All lived and showed a growth of from 18 to 24 inches in three months although weather was unfavorable. Chas. F. Higgs.

WASHINGTON

ENTIRELY SATISFACTORY

NORTH YAKIMA. Planted 900 trees with Red Cross Farm Powder. Loss about 4½ per cent. In spade dug holes loss about 10 to 20 per cent. Results in blasted holes entirely satisfactory. Jas. W. Matson.

MARKED BENEFIT

SPOKANE. Used several hundred pounds Red Cross Farm Powder in my orchard and am convinced that the beneficial effects of this treatment are very marked. The shattering of the subsoil makes available a largely increased amount of fertility. Louis A. Dyar.

ROSETTE CURED

NORTH YAKIMA. Through the use of Red Cross Farm Powder have gotten quick results from two trees badly affected with rosette. Both seem to be entirely cured. F. H. HUNTER.

MARKED IMPROVEMENT

WENATCHEE. Used Red Cross Farm Powder in blasting orchard. Portion where blasting was done shows marked improvement over the other trees. H. D. CLARK.

ROSETTE CURED

NORTH YAKIMA. Know from experience that the loss in planting trees with Red Cross Farm Powder is nil compared with the shovel and pick. I have also overcome the apple rosette by regenerating my orchard with Red Cross Farm Powder. PAUL G. KRUGER.

WEST VIRGINIA

DELIGHTED

PARKERSBURG. Planted 3600 trees with Red Cross Farm Powder. To say that we are delighted with new process is speaking mildly. Previous to this we had planted 5000 trees in spade dug holes and lost 3500. Did not lose one per cent. of the trees in blasted holes. J. MENTON CALDWELL, President
The Virginian Orchards.

GAINED TEN YEARS

WHEELING. Planted maple trees with Red Cross Farm Powder. When 10 years old they were as large as neighboring trees 20 and 25 years old, planted in the old way. R. A. HANKET.

NO ACCIDENTS

PARKERSBURG. Used a ton of Red Cross Farm Powder in one season in orchard work without slightest accident. The loss of trees planted in blasted holes did not exceed two or three per cent. Where the trees were planted without Red Cross Farm Powder from 60 to 75 per cent. died. F. P. MOATS.

New York Nurserymen Endorse Blasting

Probably the greatest nursery section in the United States is located in western New York. The centers of this industry are Dansville and Rochester. There are probably two hundred nurseries, large and small, in and around these centers.

The propagation, growing and selling of trees is the nurserymen's business. Naturally, in order to succeed, he must make a thorough study of all that pertains to the successful growing of trees. His advice as to the selection of varieties, planting and care of trees is asked by his customers and he cannot afford to make recommendations not thoroughly in accord with the best horticultural and arboricultural practice.

When a nurseryman, therefore, advises the planting of trees in blasted holes it may be safely assumed that his recommendations are based upon his best judgment and upon experience in his profession.

In order to get the views of a number of the western New York nurserymen we sent one of our representatives to interview them. Below are given brief extracts from his reports:

ROCHESTER, N. Y.

WOODLAWN NURSERIES. Believe in and encourage planting of trees in blasted holes. Requested 500 Red Cross Farmer Booklets, one to be enclosed with each shipment of trees. ALLEN L. WOOD.

GLEN BROTHERS, INC. Believe in and advocate planting of trees in tight soils by blasting. R. A. MAYO, Manager.

FAIRVIEW NURSERIES. Advocate planting trees in blasted holes. Ask for booklets and price lists to distribute to their customers.
C. G. SCHOENER, Sales Manager.

HOOKER BROTHERS. Believe in and advocate blasting for fruit trees in heavy soils or where hard subsoils exist. Asked for booklets to be given out by their salesmen.

GRAHAM NURSERY CO. Advocates planting trees in blasted holes. Promised to send us a list of their agents to enable us to send each one a supply of Red Cross Farmer Booklets for distribution to their customers.
J. M. CAMPBELL, Secretary.

HAWKES NURSERY CO. Believes in using explosives to plant trees and recommends it whenever subject comes up.
CHAS. H. HAWKES, President and Treasurer

FREDERICK E. GROVER & CO. Nursery in Wisconsin. Believes in using explosives to loosen soil.

ALLEN NURSERY CO. Advocates planting of trees in blasted holes.

McGLENNON & KIRBY CO. Believes in planting trees in blasted holes. Planted 500 acres in this way at Cooleewahee plantation, Albany, Ga., and intends doing additional work in same line down there later.

CHARLTON NURSERY CO. Advocates planting of trees in blasted holes.
E. M. OSBURN, Sec'y and Treas.

CHASE BROTHERS. Believe in use of explosives in certain soils and advocate its use. They send our booklets to those who make inquiry and whose land needs the treatment.

PHILLIPS NURSERY CO. Landscape architects. Recommend use of explosives when heavy soils are encountered.

IDEAL NURSERY CO. Advises buyers of nursery stock to loosen soil by blasting if it is heavy. Has secured several blasting jobs for the professional blaster near that locality. F. J. BLAESI.

EAGLE NURSERY CO. Believes in use of explosives for tree planting in tight soils. Requested a supply of our booklets to use in answering inquiries.

DANSVILLE, N. Y.

KING BROS. Recommend the use of explosives to loosen up the soil previous to setting out trees in heavy and clay soils. MARTIN KING.

ALTON E. RANDALL. Advocates the use of explosives where soil is heavy or tight.

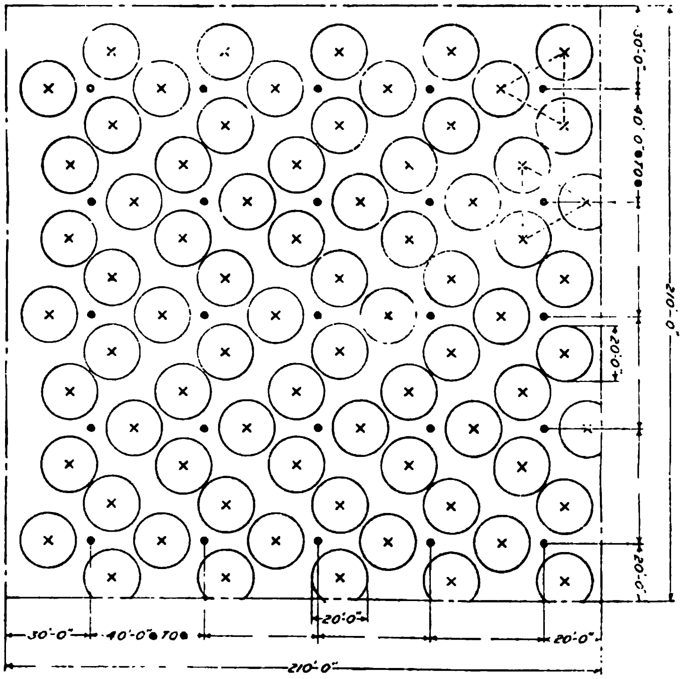
MALONEY BROS. & WELLS. Recommend the use of explosives in planting trees in heavy soils.

W. J. REILLY. Believes in blasting soil and subsoil in heavy and tight soils and recommends it.

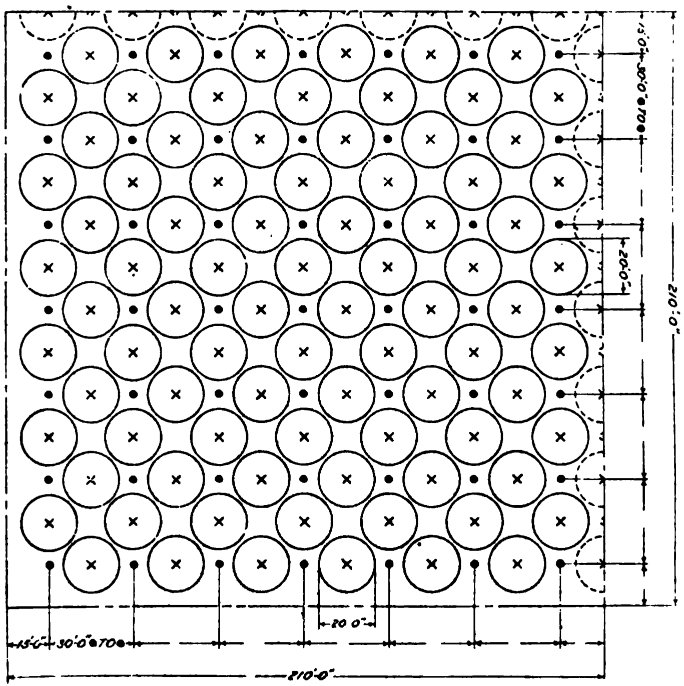
REILLY BROS. When customer has heavy or tight soil or subsoil, they recommend the blasting of the ground before planting.

WELLS WHOLESALE NURSERY CO. Advises customers when they ask about using explosives to plant their orchard trees that way; that it is a good thing if they have clay or heavy, tight soil or subsoil.

KELLEY BROS. NURSERY CO. Sells to large planters mostly. They advocate using explosives in tight and heavy soils or subsoils.



This represents a square acre of orchard set on the 40 feet square plan, with blasts on three sides of each tree. The holes are punched at the apexes of an equilateral triangle, the tree being in the center and the apexes at 10 feet distances from the tree. As shown the triangles for two adjacent rows should point in opposite direction to distribute the blasting to best advuntage. This method is best when trees are more than 30 feet apart.



This represents a square acre of orchard set on the 30 feet square plan, with rejuvenation blasts between the trees.

DU PONT

HIGH EXPLOSIVES

Second Section

Kinds, Grades and Brands

A-271 (October, 1916)

THIS HIGH EXPLOSIVES HANDBOOK is printed in two sections, this being Section 2.

Section 1 covers the Manufacture, Handling, Storage and Use of High Explosives.

Should you not already have Section 1, a copy will be sent on request.

E. I. DU PONT DE NEMOURS
& COMPANY
WILMINGTON - DELAWARE

HIGH EXPLOSIVES

Manufactured by

E. I. du Pont de Nemours
& Company

Kinds, Grades and Brands

Important Properties of Each Kind and
Class of Work to Which Each
is Particularly Adapted

Copyright, 1915
E. I. du Pont de Nemours & Company
Wilmington, Delaware

DU PONT
MONOBEL
Nº 2
REPAUNO
GELATIN
CARBONITE
Nº 1

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HIGH EXPLOSIVE PACKAGES

High explosives, except Du Pont R. R. P., are always put up in heavy paper cartridges, the paper in these cartridges being covered with a coating of paraffin. The cartridges are packed in sawdust in wooden cases containing either twenty-five pounds or fifty pounds net of explosives. On special order certain explosives are packed in cartridges which are packed first in cartons, which are in turn enclosed in wooden cases. Du Pont R. R. P., is packed in paraffined paper bags holding twelve and one-half pounds each. Four of these bags are put up in a wooden case of fifty pounds capacity.

The following table shows the size of the cartridges of each high explosive:

TABLE OF DYNAMITE CARTRIDGE SIZES

Du Pont Straight Red Cross Straight	Du Pont F Du Pont FF Du Pont FFF Du Pont Blasting Gelatin*	Du Pont Extra Red Cross Extra	Du Pont Gelatin Repauno Gelatin Red Cross Gelatin	Permissible Explosives
⅞ x 8	1¼ x 8	⅞ x 8	1 x 8	1¼ x 8
1 x 8	1½ x 8	1 x 8	1¼ x 8	1½ x 8
1¼ x 8	2 x 8	1¼ x 8	1½ x 8	
1½ x 8		1½ x 8	2 x 8	
2 x 8		2 x 8		

Kinds, Grades and Brands of Du Pont High Explosives

Straight Dynamite
25% to 60%
DU PONT
RED CROSS

Extra Dynamite
30% to 60%
†DU PONT
‡RED CROSS

Gelatin Dynamite
35% to 75%
DU PONT
REPAUNO
RED CROSS

Red Cross Gelatin is also manufactured in 90% strength, and in this strength can be packed in ⅞ x 8 cartridges.

Blasting Gelatin

DU PONT

PERMISSIBLE EXPLOSIVES

(Not Graded by Strength)

Carbonite	Monobel
No. 1	No. 1
No. 2	No. 2
No. 3	No. 3
No. 4	No. 4 (L. F.)
No. 5 (L. F.)	No. 5 (L. F.)
No. 6 (L. F.)	No. 6 (L. F.)

MISCELLANEOUS EXPLOSIVES

DU PONT QUARRY POWDER
RED CROSS FARM POWDER
RED CROSS STUMPING POWDER
DU PONT STUMPING POWDER

DU PONT R. R. P.
DU PONT F
DU PONT FF
DU PONT FFF

REPAUNO STUMPING POWDER

OIL WELL EXPLOSIVES (S. N. G.)

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* Blasting gelatin cannot be packed in cartridges less than 1¼" in diameter.
† Not manufactured in 50% strength.
‡ Manufactured also in 20% strength.

Table Showing Outside Dimensions and Shipping Weights of Cases of High Explosives

	Case No. 1 Capacity 50 lbs. net		Case No. 2, Capacity 50 lbs. net In Cartons		Case No. 3 Capacity 25 lbs. net		Case No. 4, Capacity 25 lbs. net In Cartons	
Explosive	Shipping Weight	Dimensions	Shipping Weight	Dimensions	Shipping Weight	Dimensions	Shipping Weight	Dimensions
		Length Width Depth		*Length Width Depth*		*Length Width Depth*		*Length Width Depth*
Straight Dynamite	58 lbs.	17½″x12″ x 9″			29½ lbs.	13½″x 9½″x 8″		
Extra Dynamite	"	"			"	"		
Gelatin Dynamite	"	17½″x12″ x 8″			"	"		
Blasting Gelatin	"	"			"	"		
Du Pont R.R.P. (in bags)	59 lbs.	17½″x12″ x11¼″						
Du Pont Low Powder	58 lbs.	17½″x12″ x 9″			29½ lbs.	13½″x 9½″x 8″		
Monobel No. 1	60 lbs.	17½″x13½″x11¼″	65 lbs.	18½″x16¾″x 9¾″	31½ lbs.	19″ x 9½″x 8″	34 lbs.	16¾″x10″ x 9¾″
Monobel No. 2	"	"	"	"	"	"	"	"
Monobel No. 3	"	"	"	"	"	"	"	"
Monobel No. 4	"	"	"	"	"	"	"	"
Monobel No. 5	"	"	"	"	"	"	"	"
Monobel No. 6	"	"	"	"	"	"	"	"
Carbonite No. 1	59 lbs.	17½″x12″ x 9″	60 lbs.	25½″x 9¾″x 9½″	29½ lbs.	13½″x 9½″x 8″	32 lbs.	14″ x 9¾″x 8½″
Carbonite No. 2	60 lbs.	17½″x13½″x11¼″	65 lbs.	18½″x16¾″x 9¾″	31 lbs.	19″ x 9½″x 8″	34 lbs.	16¾″x10″ x 9¾″
Carbonite No. 3	"	"	"	"	"	"	"	"
Carbonite No. 4	58½ lbs.	"			"	14″ x 9¾″x 8½″	32 lbs.	14″ x 9¾″x 8½″
Carbonite No. 5	60 lbs.	"	65 lbs.	18½″x16¾″x 9¾″	"	19″ x 9½″x 8″	34 lbs.	16¾″x10″ x 9¾″
Carbonite No. 6	"	"	"	"	"	"	"	"

The shipping weights and dimensions of cases of High Explosives vary slightly, but the above table is sufficiently accurate for all practical purposes.

Dynamite Grade Markings

The meaning of the grade designations or "percentage strength" mark on dynamite is sometimes puzzling to consumers, and often a source of misunderstanding between manufacturer and customer. Originally a 40 per cent. dynamite meant that the dynamite contained 40 per cent. actual nitroglycerin by weight, but as modern dynamites do not always contain the proportion marked, a short description of modern practice of grading may be of interest. A slight knowledge of the history of the manufacture of high explosives may also help to explain the situation.

The dynamite first manufactured on a large scale was called "No. 1 Dynamite" and consisted of 75 parts by weight of nitroglycerin and 25 parts by weight of "kieselguhr," an inert infusorial earth, consisting of microscopic tubes and shells, which has the property of absorbing three or four times its weight of nitroglycerin. This was truly a 75 per cent. nitroglycerin dynamite, but was not as strong as the 40 per cent. strength dynamites made to-day, some of which may contain even less than 40 parts in a 100 by weight of actual nitroglycerin. The kieselguhr acts only as an absorbent. It does not assist in the explosion and permits making only one grade of dynamite, that in which the kieselguhr holds nearly all the nitroglycerin it can. If more nitroglycerin is added, the dynamite leaks nitroglycerin to a dangerous extent, and if less nitroglycerin than 75 per cent. is used the dynamite becomes insensitive, so that a mixture of 40 per cent. of nitroglycerin and 60 per cent. of kieselguhr cannot be detonated. The kieselguhr is chemically inert. A pound of 75 per cent. kieselguhr dynamite does exactly as much work and no more than three-fourths of a pound of pure nitroglycerin.

The "Straight" dynamites in present use in the United States were originally known as "active-base" dynamites, in contradistinction to the kieselguhr dynamites which had an inert base. The active-base dynamites at first substituted a crude gunpowder for the kieselguhr, but as this was so poor an absorbent it was not possible to make a dynamite containing more than 30 or 40 per cent. of nitroglycerin; a mixture of wood meal and nitrate of soda was used instead of gunpowder. Using these two ingredients, dynamites with a nitroglycerin content ranging from 20 to 60 per cent. could be made, worked, packed and exploded.

Furthermore, with an active base like wood meal and nitrate of soda, a dynamite having only 40 per cent. nitroglycerin will develop as much power or more than a 75 per cent. kieselguhr dynamite. A definite proportion of wood meal to nitrate of soda makes an explosive not too wet to leak nor yet too dry to be packed into the paper shells. More wood meal and less nitrate are used in dynamite with more nitroglycerin, and more nitrate and less wood meal or wood meal of less absorbing capacity like fine-grained sawdust, are used in the dynamites containing less nitroglycerin. Using these three ingredients with minute proportions of other non-explosive substances required to stabilize the dynamite, a type of high explosives known as "Straight Dynamites" was made, which constitutes the standard of strength against which all other dynamites are graded.

Other explosive substances incorporated into dynamite increase its power over straight dynamite and it is necessary to reduce the amount of nitroglycerin and otherwise modify the formula so that the new compound develops the same power in actual work as the standard dynamite. For instance, guncotton dissolved in nitroglycerin makes a sticky, jelly-like substance which, added to the wood meal and nitrate of soda, makes an explosive much more powerful than one in which nitroglycerin alone is used. Such an explosive, graded on its actual content of nitroglycerin, would be so much more powerful than the same grade of straight dynamite as to be unsafe and unsatisfactory in work where the blasters were accustomed to using the standard grade.

Many explosives in the market now containing no nitroglycerin at all are equal to a 40 per cent. straight nitroglycerin dynamite, and these are graded as described on the basis of strength developed, not on the nitroglycerin content. Other powerful explosives widely used contain only small amounts of nitroglycerin—from 5 to 10 per cent. sometimes—which, nevertheless, develop as much power, weight for weight, as 50 and 60 per cent. straight nitroglycerin dynamites. It is readily seen, therefore, that a customer should not feel that he has been injured when he finds that the dynamite he has been buying as 40 per cent. strength has actually less than 40 per cent. nitroglycerin in it. While the straight nitroglycerin dynamites are still on the market, they are the only ones that actually contain the same percentage of nitroglycerin as the percentage strength marked. In many ways they are distinctly inferior, as they are too quick for a good deal of work, they are more easily frozen and are much more sensitive to rough handling.

Explosive Nomenclature

In the last few years there has been a tendency to drop the word "nitroglycerin" in speaking of any kind of explosives. This is partially due to so many different kinds of explosives now being manufactured which are equal in strength and yet do not contain the same per cent. of nitroglycerin, although they contain other explosive ingredients which bring them up to the strength designated.

When dynamite was first manufactured, the only explosive ingredient known was nitroglycerin. At that time they adopted the terms "40 per cent. Nitroglycerin," "60 per cent. Nitroglycerin," etc., which meant that there was 40 per cent. of nitroglycerin or 60 per cent. of nitroglycerin in that particular explosive. Later on gelatin dynamite was manufactured, the corresponding strengths of which do not contain as large a per cent. of nitroglycerin, but in addition contain other explosive ingredients which enable the manufacturer to sell gelatins equal in strength to the corresponding strength of nitroglycerin dynamites. The same applies to explosives known as "Extra" dynamites.

Believing that there would be considerable confusion in still maintaining the old terms "40 per cent. Nitroglycerin" and "60 per cent. Nitroglycerin," and also due to the gelatins, extras and many other explosives not containing the same per cent. of nitroglycerin that the "Straight" nitroglycerin explosives contain, it was deemed best to use the terms "40 per cent. Strength," "60 per cent. Strength," etc.

For some time there seemed to be no short and definite term which could be applied to nitroglycerin explosives as a whole. We finally adopted the word "Straight" to indicate those explosives which contain nitroglycerin equal to the per cent. strength, or where the character of the explosive placed it in that class.

Many of the explosives of low-freezing qualities are made in the straight, extra and gelatin kinds.

The following is a list of the high-freezing and low-freezing explosives which we manufacture:

High-Freezing

- Du Pont Straight
- Du Pont Extra
- Du Pont Blasting Gelatin
- Monobel No. 1
- Monobel No. 2
- Monobel No. 3
- Carbonite No. 1
- Carbonite No. 2
- Carbonite No. 3
- Carbonite No. 4

Low-Freezing

- Red Cross Straight
- Red Cross Extra
- Red Cross Gelatin
- Du Pont Low Powder
- Du Pont Gelatin
- Repauno Gelatin
- Monobel No. 4
- Monobel No. 5
- Monobel No. 6
- Carbonite No. 5
- Carbonite No. 6
- Du Pont Quarry Powder
- Red Cross Farm Powder
- Red Cross Stumping Powder
- Du Pont Stumping Powder
- Repauno Stumping Powder

Low-Freezing Explosives and Their Freezing Point

We are frequently asked by customers, "What is the actual freezing point of your low-freezing explosives, such as Red Cross Dynamite and Du Pont Gelatin Dynamite?" It is a simple question and would seem an easy one to answer, but it is not. The "straight unvarnished truth" is "we do not know," but few customers will believe that when we tell them.

If you asked an ordinarily well-educated man, "What is the freezing point of water?" he would say promptly and certainly, "32° F." But if you asked a very learned physicist the same question he would probably qualify his answer by saying that it depended on several things, the nature of the container, the pressure, and whether the liquid was moving or absolutely still. If water is kept absolutely quiet, its temperature may be lowered to 14° F. without its freezing (Kent). In a glass tube ¼ inch diameter it freezes at 23° F. In a glass tube 1/200 inch in diameter it freezes at from 3° F. to 4° F. (Trautwine).

Water is one of the simplest of chemical compounds, while the dynamites, especially the low-freezing ones, are exceedingly complex, both chemically and physically, containing, as they do, various nitrated substances or compounds, finely ground inorganic nitrates and carbonaceous ingredients.

Chemically pure nitroglycerin, under normal conditions, will freeze at about 55° F. However, the actual freezing temperature of the ordinary high-freezing dynamites and gelatins may be considerably lower.

The theoretical freezing point of ordinary sweet glycerin is about 62° F., yet it is used in anti-freezing mixtures for automobiles and gas meters. In the coldest weather a drum of frozen glycerin is considered rather a curiosity at the dynamite works where thousands of drums of glycerin are stored all winter in the open.

Freezing points, then, are not as simple and fixed temperatures as they seem. Even a very simple substance may freeze at very different temperatures under different conditions.

The temperatures at which our Red Cross Dynamites and Du Pont Gelatin Dynamites will freeze vary in a similar manner, and therefore no definite figure can be given as their freezing temperature. However, they have been known to remain unfrozen when exposed to a temperature of 40° F. below zero for a week. On the other hand, instances have been known where these powders have frozen at temperatures higher than 0° F. The low freezing qualities of these explosives is evidenced by the fact that very few instances of powder being frozen in the field have been encountered.

They freeze much easier and quicker if they have once been frozen and then thawed as in the second winter storage.

From the foregoing you will see how unfair it is to insist on our naming or guaranteeing a specific freezing point on our low freezing explosives, as some of our customers are trying to have us do; for it cannot honestly be done by this company or any manufacturer of low-freezing explosives.

We can only say that our low-freezing explosives represent the best in that respect that science has so far produced, and bear the Du Pont guarantee as to quality.

The Properties of Du Pont High Explosives

The property of high explosives, which gives them their value in blasting operations, is primarily the production of a large volume of gases of high temperature in a short space of time from a relatively small solid. This depends on what may be conveniently called its density, strength and quickness. Secondary properties, such as stability, sensitiveness, resistance to water, fumes, and plasticity are important, but only indirectly affect the character of the explosion. The density of an explosive may be defined as its weight compared with its bulk. High density explosives are those which have the greatest weight in the least space, or when packed contain a less number of cartridges of a given size to a case of a given weight.

The strength of an explosive depends on the volume of gases generated and, to some extent, on the quickness with which these gases are evolved. There is no very satisfactory measure of strength for commercial explosives for the reason that small charges fired in testing apparatus do not give the same relative results that large charges do in actual blasting conditions, and with two explosives that by every test in laboratory apparatus are shown to be of equal strengths, in a given rock one may do very much better work than the other.

The standard of strengths of Du Pont High Explosives is the straight dynamite, which contains the actual percentage of nitroglycerin shown by the per cent. strength marking. Thus, a 40 per cent. strength straight dynamite contains 40 per cent. actual nitroglycerin by weight. A 40 per cent. strength gelatin contains less than 40 per cent. of nitroglycerin, but other explosive ingredients make up the strength so that it is equal in actual execution to the standard.

Quickness of an explosive is the speed with which it generates its gases. This is not the same thing as the velocity of detonation, which is the speed with which an explosion spreads from one end of a mass of explosives to the other, but there is a certain relation between the two. An explosive is said to be quicker than another when it shatters and smashes the material blasted, and breaks it finer than the other.

Stability is keeping quality, freedom from changing on storage.

Sensitiveness is a quality a certain amount of which is desirable, but beyond that undesirable. An explosive should withstand the ordinary and reasonable usage in handling and transportation without danger, yet susceptible to complete detonation by the standard detonator. If too insensitive it is difficult or impossible to detonate it entirely.

The fumes given off by various explosives are different in quality to suit different requirements. In close work, tunneling and mining, it is very important that the obnoxious fumes be reduced to a minimum, and other qualities may be sacrificed, to some extent, to diminish the amount of noxious fumes. In open work such as quarrying and open contracting work, fumes are of no consequence, so a different explosive may become more economical.

Resistance to water is desirable in almost every high explosive as, except in some coal mines, the bore holes almost always contain some water. For submarine work, however, a very high water-resisting explosive is desirable, while fumes again are of no moment.

Plasticity is that property of an explosive by virtue of which it stays where it is put. The gelatin explosives are examples of this character. In the bore holes called "uppers" in tunneling and mining, it is very desirable that the explosive, when placed in the bore holes, should stay there and not run out. Plastic explosives are required for this class of work.

Cost also affects the adaptability of an explosive for a given purpose. Often a cheaper explosive will do better work than a very expensive one, while in other places the cost of the explosive is such a small percentage of the total expenses, that the most costly is the most economical.

While several types of high explosives have a wide range of application, no one type is adapted to every range of operation. The large variety of high explosives of every grade and kind made by the Du Pont Company makes possible the selection of the right kind of explosive for any kind of work.

Properties Common to All Types of Du Pont High Explosives

A Du Pont No. 6 blasting cap or a No. 6 electric blasting cap, or stronger, should be used with all Du Pont explosives to secure best results.

All high explosives should be handled with the greatest care possible.

No attempt should be made to use high explosives when frozen. They should be thawed in a suitable apparatus according to the directions furnished by the Du Pont Company.

The guaranteed strength is marked on every case and cartridge of Du Pont High Explosives.

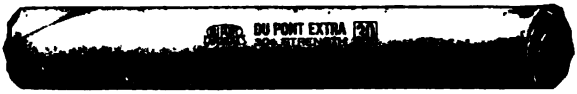
DU PONT STRAIGHT

25 Per Cent. to 60 Per Cent. Strength

This is a very quick and powerful explosive. It resists water well and is recommended for open work in hard, tough material where a shattering action is desired. It is excellent for mudcapping, scrapping boilers and machinery, and is necessary in the 50 and 60 per cent. strengths for ditching by the propagated method. It is not low freezing. The fumes are likely to be objectionable and it is somewhat more sensitive than the other types of high explosives.

DU PONT EXTRA

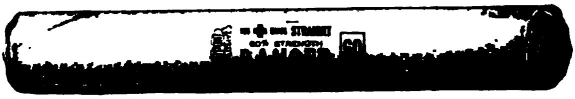
30 Per Cent. to 60 Per Cent. Strength



The extra dynamites are not so quick nor shattering in their action as straight dynamite, but have more of a heaving and lifting effect. They are better suited for soft materials and for close work than straight dynamite, because their fumes are not so objectionable. They are not low freezing and they do not resist water very well, so the cartridges should not be slit nor left long in wet bore holes.

RED CROSS STRAIGHT

25 to 60 Per Cent. Strength



This dynamite is adapted to every purpose that a straight dynamite is, with the exception of ditch blasting by the propagated method. Red Cross

Straight is a quick, powerful explosive suitable for open work of every description. It is low freezing and withstands very cold weather for a long time without freezing. When they are frozen, however, they require to be thawed as in the case of any other high explosive.

Red Cross Straight Dynamite is a good all-year-round explosive and is particularly well adapted to well-drill hole blasting, and other quarry and construction work. It stands water as well as any explosive except the gelatin. It is not recommended for close work unless the ventilation is adequate.

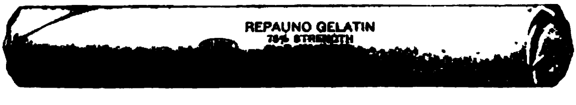
RED CROSS EXTRA

20 to 60 Per Cent. Strength

This explosive is similar in its action to the Du Pont extra dynamite, but is low freezing. It is admirably suited to work in soft rock, in hard rock where it is not desirable to shatter the material, in sand, clay and earth excavation of every kind. It works extremely well in mining soft ore where there is not much water. It can be used in close work with much more comfort than straight dynamite, as the fumes are not so objectionable. It is an all-year-round explosive for general purposes, but should not be used in wet bore holes unless the cartridge wrappers are not cut or broken and the charge not left too long in the water.

REPAUNO GELATIN

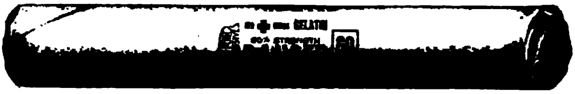
35 to 75 Per Cent. Strength



This brand is the well-known standard gelatin dynamite. It is a dense (heavy) plastic explosive, highly water-resisting, and gives a minimum of fumes on explosion. It is low freezing. Gelatin dynamites are used in very wet work, under water, and in close work where ventilation is deficient. For tunneling and for mining hard rock in wet places gelatin dynamites are unsurpassed. They do not work well unless strongly confined and are unsuitable for such work as mudcapping.

RED CROSS GELATIN

35 to 90 Per Cent. Strength



This gelatin is low freezing. It can be used in close work the same as Repauno Gelatin, but the character of its fumes are somewhat different. It is not to be understood that they are better in any way, but it sometimes happens that miners accustomed to one kind object to the other. The nature of the material worked also has an effect on the fumes, and it often happens that where one kind of gelatin gives objectionable fumes, the other is free from this objection. Red Cross Gelatin is dense, plastic and water resisting.

DU PONT GELATIN

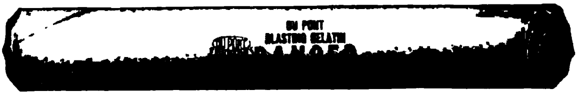
35 to 75 Per Cent. Strength

Du Pont Gelatin has in a great measure replaced other brands of gelatin dynamite because it combines all their virtues of density, plasticity, water resistance, comparative freedom from obnoxious fumes, and in addition, is low freezing. It does not become chilled or lose its efficiency unless exposed to very low temperature for a prolonged period. It is used to advantage in every kind of work to which other gelatin dynamites are adapted, and has been used in close work and badly ventilated mines and tunnels with even better results than the other brands of gelatin dynamites. It is adapted to a wider range of work than any other high explosive.

It is especially adapted for close work of every kind, mining and tunneling in the hardest rock under most adverse conditions. The fact that in mining operations thawing is generally unnecessary gives a feeling of safety to the mine operators which they have never enjoyed before this explosive was used.

DU PONT BLASTING GELATIN

100 Per Cent. Strength



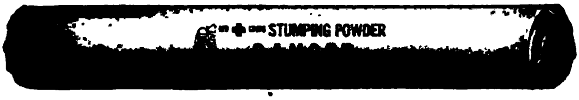
This is the strongest and quickest high explosive manufactured. It can be used in close work as it gives a minimum of fumes when exploded. It is practically water-proof and hence can be used in all kinds of wet or submarine work. It is not low freezing and **must be thawed when frozen** before using to obtain good results. It must be handled carefully when frozen, because when in this state it is sensitive to shock, while in a thawed condition it can be handled as safe as any explosive.

It is especially adapted to blasting hard material in tunnels, shaft sinking and in places where considerable water is encountered.

RED CROSS FARM POWDER

Red Cross Farm Powder is an explosive designed especially for scientific agriculture, especially for tree planting, subsoiling, ditching by the electrical method and ordinary stump blasting. It is an ideal all-'round explosive for use on a farm. It is low freezing.

RED CROSS STUMPING POWDER



Red Cross Stumping Powder is similar to Red Cross Farm Powder, but is quicker and stronger and intended for boulder blasting and stumping in lighter, less resisting soil. It is low freezing.

DU PONT STUMPING POWDER

A low-freezing dynamite especially adapted to stumping requirements on the West Coast. It does not stand water well, hence cartridges should not be slit or left long in wet bore holes.

REPAUNO STUMPING

An explosive similar to Du Pont Stumping for West Coast requirements, and having somewhat the same general characteristics. It is low freezing.

DU PONT QUARRY POWDER (Low Freezing)

This is a new explosive produced to meet the demand for a powerful, quick-acting explosive for open work only. In the great majority of open quarry work requiring the use of high explosives, this powder will be found satisfactory for springing, well-drill hole blasting, ordinary drill holes, block hole and plug hole shooting, mudcapping, 'dobying and blistering.

DU PONT R. R. P.

This is a black, granular, free-running explosive packed in paraffine paper bags containing 12½ pounds each, and packed four bags to the 50-pound case. It is low freezing and requires no thawing except when long exposed to severe weather conditions. It is used extensively for stripping and on railroad construction work in both rock and earth. It resists water poorly, and requires a detonator of at least 5 pounds of 40 per cent. straight dynamite for every 25 pounds of Du Pont R. R. P.

DU PONT F

A black granular powder slightly stronger than Du Pont R. R. P. It is packed in cartridges and is somewhat more water resisting. It is also low freezing. It is suitable for open work in soft and shaly ground and in well-ventilated mines.

DU PONT FF

Similar to Du Pont F, but stronger and quicker.

DU PONT FFF

This is similar to Du Pont FF, but is still stronger and quicker.

A full description of Du Pont Permissible Explosives for gaseous or dusty coal mines is given in the Permissible Explosive section of this booklet.

Du Pont Permissible Explosives

For Gaseous or Dusty Coal Mines

Monobel and Carbonite

Permissible Explosives are those which have passed certain tests prescribed by the Bureau of Mines at the U. S. Mining Experiment Station at Pittsburgh, Pa., when used under the following conditions:

First: Where the explosive is in all respects similar to the sample submitted by the manufacturer for tests.

Second: Where No. 6 detonators—preferably No. 6 electric detonators (blasting caps or electric blasting caps)—are used, except certain explosives which require a detonator of even greater strength than a No. 6.

Third: Where the explosive, if frozen, shall be thoroughly thawed in a safe and suitable manner before use.

Fourth: Where the quantity used for a shot does not exceed 1½ pounds, properly tamped.

Du Pont Permissible Explosives are Monobel No. 1, Monobel No. 2, Monobel No. 3, Monobel No. 4, Monobel No. 5, Monobel No. 6, Carbonite No. 1, Carbonite No. 2, Carbonite No. 3, Carbonite No. 4, Carbonite No. 5 and Carbonite No. 6.

Monobel No. 4, Monobel No. 5, Monobel No. 6, and Carbonite No. 5 and Carbonite No. 6, are low freezing Permissible Explosives, and do not freeze except after prolonged exposure to very low temperatures.

The Use of Du Pont Permissible Explosives

The most serious accidents in bituminous coal mines are due to explosions of mine gas or coal dust or mixtures of both which are started by the flame from the explosives used in blasting the coal. Careful study and tests have proved that mine gas and coal dust can be ignited more easily by some blasting explosives than by others and that large charges of any explosives are more likely to ignite mine gas and coal dust than smaller ones. Charges of explosives in bore holes which are well tamped from the charge to the collar with damp clay are less likely to ignite gas and dust than charges which are tamped only with "bug dust," slack coal or when tamped insufficiently with any material.

Shots which are insufficiently tamped or tamped with "bug dust," coal slack or similar combustible material, are exceedingly dangerous, owing to the chance of the flame igniting the coal dust. Moist clay should be used and it should fill the bore hole from charge to mouth.

The practice of placing the primer cartridge, with blasting cap and a short piece of fuse attached, in the mouth of the bore hole, lighting the fuse, ramming the cartridge down into the bore hole with little or no tamping, is exceedingly dangerous, both from the fact that the charge is not sufficiently tamped and because the short fuse is liable to burn through and explode the shot before the miner can reach a safe place. This practice is sometimes called short fusing or "skin-'em-back."

It is of the utmost importance that the strongest detonators (blasting caps or electric blasting caps) should be used with permissible explosives; they are less likely to cause ignition of gas or dust when detonated completely. Weaker detonators and detonators which have become damp often ignite the explosives and set them on fire, instead of exploding them, and this invariably ignites mine gas, if any is present, and causes a more or less disastrous fire or explosion.

The Du Pont Permissible Explosives are made expressly for blasting coal in mines where gas or dust may be present. They are made in varieties, each one adapted for a particular kind of coal. The most satisfactory kind of Du Pont Permissible Explosives for any one place can only be determined by experience. They are designed for soft coal, medium coal and hard coal and for dry and wet work. Some of them are so made that they will not freeze unless exposed to very severe weather conditions for a long time.

Permissible explosives require a blasting cap or electric blasting cap to detonate them. They cannot be exploded with fuse or squib alone. A No. 6 blasting cap or electric blasting cap should be used to explode them, as they are not passed by the Government as permissible explosives if a weaker detonator is used.

Two different kinds of permissible explosives must not be used in the same bore hole, and neither blasting powder nor dynamite must ever be used in the same bore hole with permissible explosives.

Firing permissible explosives by electric blasting caps is far safer in gas or dust than firing by means of blasting cap and fuse. For electrical firing a Du Pont Blasting Machine, coil of leading wire and Du Pont No. 6 electric blasting caps should be used. Two or more bore holes may be fired at the same time, and if they are too far apart for the wires from the electric blasting caps to join each other, it is necessary to have connecting wire between the bore holes.

A DU PONT No. 6 BLASTING CAP OR No. 6 ELECTRIC BLASTING CAP (RED LABEL), OR STRONGER, SHOULD BE USED WITH ALL DU PONT PERMISSIBLE EXPLOSIVES TO SECURE BEST RESULTS

Classification of Du Pont Permissibles

MONOBEL No. 1

Monobel No. 1 is a permissible explosive, used principally in outside work. It is especially suitable for rock work, trimming and for blasting out the "bone" in coal mines where permissible explosives are required to be used. It may also be used with advantage in narrow seams of very hard coal.

MONOBEL No. 2 and MONOBEL No. 4

Monobel No. 4 is Low Freezing

Monobel No. 2 and Monobel No. 4 are intended for use in hard coal, hard-shooting soft coal and coking coal. They are also used for blasting bottom and top rock, but are not quite so quick acting as Monobel No. 1. They are a little slower acting and usually give better results in blasting coal. Monobel No. 2 and Monobel No. 4 are as strong as the same weight of 60 per cent. strength dynamite, but, being much lighter, there are about one-third more cartridges to the case. On this account a cartridge of Monobel will not do the same amount of work in rock as the same size cartridge of 60 per cent. strength dynamite. A *cartridge* of Monobel No. 2 and Monobel No. 4 is about equal in strength to the *same size cartridge* of 35 per cent. strength dynamite, but is much slower in action and does not shatter the coal as much. Monobel No. 2 and Monobel No. 4 are better adapted for blasting hard coal than either blasting powder or dynamite, because they make very little smoke or fumes, so that the miner can work more comfortably and can see what he is doing much better on account of the clearer air. With a little practice, a miner can easily learn how to get out the coal with Monobel No. 2 and Monobel No. 4 as cheaply as he can with either blasting powder or dynamite.

In wet work, the cartridges of Monobel should not be slit or broken and should not remain in wet holes any longer than just time enough to load, tamp and fire the shot.

MONOBEL No. 3 and MONOBEL No. 5

Monobel No. 5 Is Low Freezing

Monobel No. 3 and Monobel No. 5 are the slowest acting of the Monobel explosives and are especially adapted to mining screened coal. They are just as strong as Monobel No. 2 and Monobel No. 4, but are so much slower in their action that miners who have learned to use them properly can mine the softest coal known without breaking it any more than if blasting powder were used and at no more expense. Monobel No. 3 and Monobel No. 5 give off very little smoke and fumes, which permits the miner to return to the face quicker than where blasting powder is used and to detect dangerous conditions in the roof with more certainty on account of being able to see better. These powders should not remain longer than absolutely necessary in wet bore holes before firing. They are packed in the same way, having the same number of cartridges in a case. Monobel No. 3 freezes rather easily and should be thoroughly thawed before using.

MONOBEL No. 6

Low Freezing

Monobel No. 6 is a low-freezing grade of Monobel, slightly slower than Monobel No. 1 but quicker and more shattering in its action than Monobel No. 2. It is practically fumeless (does not require thawing, except under severest weather conditions), and can be successfully used in shooting hard coal and coking coal where an explosive but little quicker than Monobel No. 2 and Monobel No. 4 is desired.

All grades of Monobel must be stored in a dry place, as they begin to lose efficiency after they have become moist. In wet work it is advisable not to break or cut the paper wrappers of the cartridges, but to load them entire and fire the blast as soon after loading as possible. Where the bore holes are dry and the coal is hard, the Monobel explosives will give best results if the cartridge shells are slit lengthwise once or twice with a sharp knife and the cartridges loaded one at a time and pressed firmly into the back of the bore hole with a tamping stick.

If Monobel No. 3 or Monobel No. 5 shatter the coal too much, the charge may be loaded in the bore hole without slitting the cartridges or pressing in hard enough to break them.

This will leave an air space around the charge, which will cause the force of the blast to spread and bring down the coal in large pieces.

REMEMBER THAT ALL MONOBEL CHARGES MUST BE TAMPED TO THE MOUTH OF THE BORE HOLE FOR SAFETY, EFFICIENCY AND ECONOMY.

MONOBEL PACKING

All grades of Monobel are put up in cartridges 1¼ x 8 inches and 1½ x 8 inches. There are four styles of case packings:

Fifty pounds in a wooden case, the cartridges packed in bulk.

Fifty pounds in a wooden case containing four pasteboard cartons, each carton containing 12½ pounds of Monobel.

Wooden cases containing 25 pounds packed in bulk.

Wooden cases containing 25 pounds enclosed in two pasteboard cartons, each carton containing 12½ pounds Monobel.

A 50-pound case of Monobel packed in cartridges 1¼ x 8 inches will contain about 135 cartridges.

A 50-pound case of Monobel packed in cartridges 1½ x 8 inches will contain about 100 cartridges.

The 25-pound cases, of course, contain one-half as many cartridges of any given size as the 50-pound cases.

A DU PONT No. 6 BLASTING CAP OR No. 6 ELECTRIC BLASTING CAP (RED LABEL), OR STRONGER, SHOULD BE USED WITH ALL DU PONT PERMISSIBLE EXPLOSIVES TO SECURE BEST RESULTS

CARBONITE

The Carbonites are permissible explosives which are adapted for work in nearly every condition in coal mining. They are better adapted than the Monobels for wet work and they are sold at a price considerably lower than the Monobels. They are, however, likely to make somewhat more smoke and fumes than the Monobels and they require better ventilation.

It is possible to select one of the six grades of Carbonite which will be found to be adapted for coal mining operations under almost every conceivable condition.

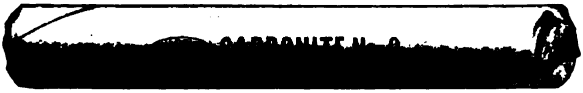
CARBONITE No. 1

Carbonite No. 1 is intended for the same kind of work as Monobel No. 2. It makes a little more smoke and fumes than Monobel does, but stands water better. It is not quite so strong as Monobel No. 2.

CARBONITE No. 2 and CARBONITE No. 5

Carbonite No. 5 Is Low Freezing

Carbonite No. 2 and Carbonite No. 5 are not quite so strong nor quick as Carbonite No. 1. They do not shatter the coal as much as Carbonite No. 1 and can be used more satisfactorily in a softer coal or where it is desired to make more lump coal. They are similar to Carbonite No. 1 in respect to fumes and water resistance.



CARBONITE No. 3 and CARBONITE No. 6

Carbonite No. 6 Is Low Freezing

Carbonite No. 3 and Carbonite No. 6 are slower and less shattering even than Carbonite No. 2 and Carbonite No. 5. They are intended for very soft coal and are among the most popular of Du Pont Permissible Explosives.

CARBONITE No. 4

This is the slowest acting explosive of the Carbonite class, and when used properly will bring down the coal with little, if any, more breakage than when Monobel No. 3 is used. Like the other Carbonites, it stands water well and when completely detonated, does not give off much noxious smoke and fumes.

Carbonite No. 1, Carbonite No. 2, Carbonite No. 3 and Carbonite No. 4 freeze at temperatures from 45° to 50° F., and when frozen will not explode properly, will give off much worse fumes and are more liable to ignite any gas or dust that may be present. They must be thoroughly thawed before using.

Carbonite No. 5 and Carbonite No. 6 are low freezing and do not require to be thawed unless they have been exposed for a long time to extreme weather conditions. Carbonite No. 5 and Carbonite No. 6 have frequently been used throughout the entire winter in a cold climate without freezing and without the necessity for thawing them.

All grades of Carbonite resist water well. If the bore holes are very wet, the cartridges should not be slit. When it is desired to slow down the action of the explosive, the cartridges should be loaded without slitting and without pressing them so hard that they will break. This will leave an air space around the cartridges which will have the effect of making the explosion spread. For the most effective and safest work all bore holes should be tamped from the charge to the mouth.

Carbonite Packing

All grades of Carbonite are put up in cartridges 1¼ x 8 inches and 1½ x 8 inches. These cartridges are enclosed in wooden cases containing 25 pounds or 50 pounds, as ordered.

Kind of Carbonite	Size of Cartridges	Approximate Number of Cartridges to the 50-Pound Case.
Carbonite No. 1	1¼ x 8 in.	100
Carbonite No. 1	1½ x 8 in.	75
Carbonite No. 2	1¼ x 8 in.	130
Carbonite No. 2	1½ x 8 in.	100
Carbonite No. 3	1¼ x 8 in.	130
Carbonite No. 3	1½ x 8 in.	100
Carbonite No. 4	1¼ x 8 in.	105
Carbonite No. 4	1½ x 8 in.	80
Carbonite No. 5	1¼ x 8 in.	130
Carbonite No. 5	1½ x 8 in	100
Carbonite No. 6	1¼ x 8 in.	130
Carbonite No. 6	1½ x 8 in.	100

A DU PONT No. 6 BLASTING CAP OR No. 6 ELECTRIC BLASTING CAP (RED LABEL), OR STRONGER, SHOULD BE USED WITH ALL DU PONT PERMISSIBLE EXPLOSIVES TO SECURE BEST RESULTS

Advantages of Electric Firing

Electric firing of permissible explosives is recommended by the Bureau of Mines as being safer and more effective than any other method. Some of the advantages are that the blaster can fire a shot at the exact time desired, when every one, including himself, is out of the way and protected from the flying material. It saves time, as the shot can be fired when ready and no time is lost waiting for the fuse or squib to burn.

Hang-fires and premature explosions are practically eliminated. Two or more shots can be fired at the same time. Electric blasting caps are sufficiently water resisting to be used in bore holes in coal mines that are full of water. The smoke from the burning fuse and the burning squib is done away with. There is no spark or flame projected into the room from the ignition of the electric blasting cap. Electric blasting caps are sealed up, which makes them much safer for handling.

Electric Safety Lamps for Miners

If there is any place on or under the earth where an open hat lamp is out of place, it is on the hats of the men who carry cases of dynamite or kegs of powder around in the mines. This applies not only to coal mines, but to mines of all kinds where explosives are used. The practice of the powder men of carrying explosives on their shoulders with a lighted open hat lamp is not nearly so rare as mine superintendents may imagine, and even if the man who actually carries the explosive puts out his light or carries his lamp in his free hand, the danger of sparks and snuff igniting his explosive is not entirely done away with. If he has another man walk ahead of him to light the way, the hat lamp may trail sparks after it. If the man who carries the explosive slips or falls, he may bring the light and the explosive together with disastrous results.

Many accidents occur every year in all kinds of mines from open hat lamps coming in contact with explosives, either dynamite, blasting powder, or blasting caps. Whether the open light is supplied by oil or paraffin in a lamp or if it is a candle, it is dangerous to handle any kind of explosives near it. Moreover, there is no necessity of it nowadays. There are several kinds of electric hat lamps on the market, which the Bureau of Mines has sanctioned for use in gaseous and dusty coal mines and which are both convenient and efficient and admirably adapted for the use of the men who handle explosives in any kind of mine. They will not ignite powder dust raised, sometimes, in the operation of pouring powder from a keg; they will not drop hot, flaming oil or grease into boxes of blasting caps. In fact, they can hardly cause an accidental explosion with dynamite or powder under any conceivable condition and the mine owner who really has the "Safety First" principle at heart, should seriously consider equipping his men with one of the several types of electric safety hat lamps. There are two kinds of portable electric lamps. One designed for a hand lamp which contains its own battery; the other is designed for a hat lamp only and is connected by means of a flexible cord to the battery which is worn on the belt. Of these two the latter would probably be preferred by the majority of powder men, as it projects the light forward by means of a reflector and it also allows the free use of both hands. These lamps have been made up with both storage and primary batteries; the latter would probably be the more convenient, unless the mine were equipped for charging storage batteries.

The Oldest Powder Mill in America

Built in 1802 on the banks of the Brandywine, near Wilmington, Delaware, where it still stands

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Blasting Pole and Post Holes

A Quick, Economical Method

DU PONT

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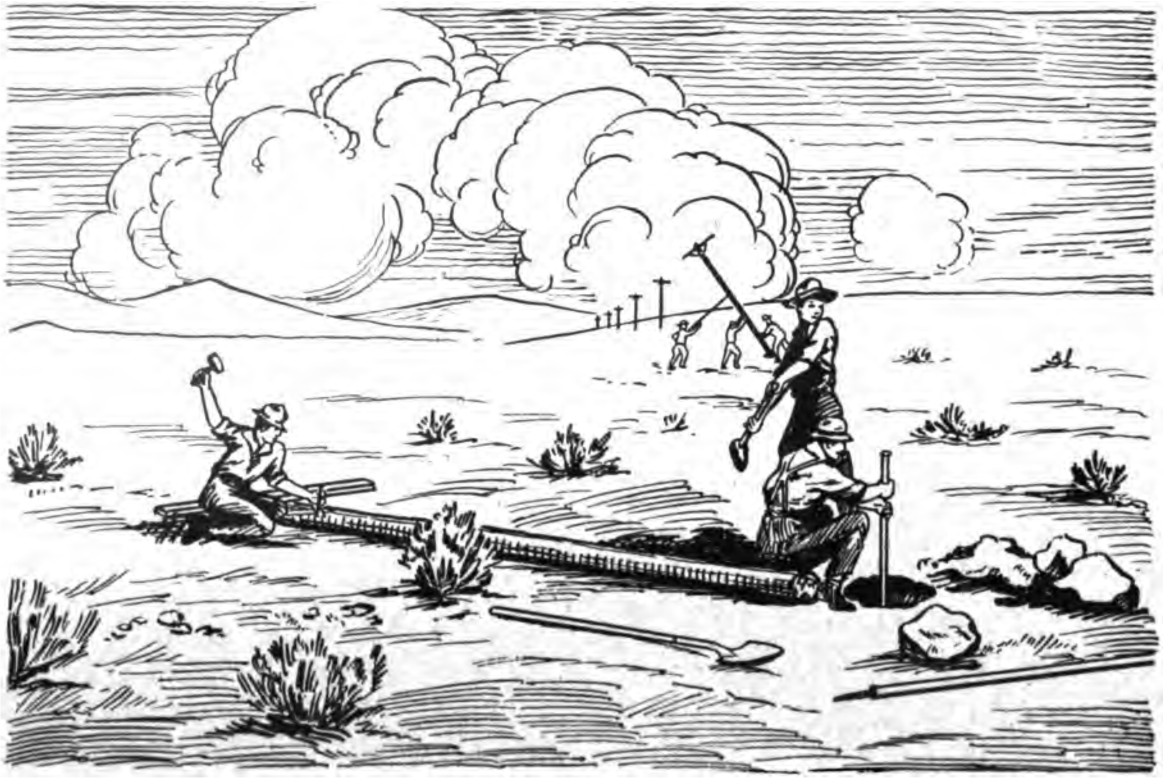
Established 1802 Wilmington, Del.

A-397, Oct., 1915



DRILLING FOR BLASTING POLE HOLES IN VERY HARD GROUND

Blasting Pole and Post Holes

The usual methods of digging holes by hand labor are too well known to require a detailed discussion.

The class of labor most satisfactory for doing this work is rapidly becoming more difficult to procure.

Hole digging by the old methods is laborious work—nearly every man wishes to become a lineman or to change to some other job.

The cost of hole digging depends on the nature of the ground encountered, and is becoming more and more expensive, especially for deep holes, for long poles.

There is a growing desire for more work with the same number of men or the same amount of work from a smaller number of men.

Either desire may be fulfilled by adopting the new methods of hole blasting.

When soft, easy digging is encountered for the full depth of the hole, little improvement can be made over the old methods.

When tight clay, hard pan, shale, or rock is encountered a rational use of explosives will both hasten and cheapen the work.

Blasting Shallow Holes in Hard Ground

When hard ground is encountered and the location of the hole determined, the shovelers should first remove the soft surface to a depth of from 6 to 8 inches, or down to the hard ground, and to the full diameter of the desired hole. This will prove helpful even where there is but a few inches of soft ground. The hole is then ready for punching the bore hole for loading.

STEEL PUNCH BAR OR DRILL
Should be made of 1⅛ inch steel and 6 inches longer than the depth of holes to be made.

Punching the Bore Hole.—The bore hole is a small hole made for loading the explosive and should be located in the center of the shallow hole already shoveled out. This bore hole should be 1½ inches in diameter. Where deep holes are needed it should be 2 inches in diameter, as there must be room for loading the long charge of dynamite.

The method of punching the bore hole depends on the nature of the ground. In clay it may be easily put down by means of a long churn drill, using a little water. For harder ground a heavy drive point or drill can be driven down and loosened by pounding on the sides, so that it can be easily removed.

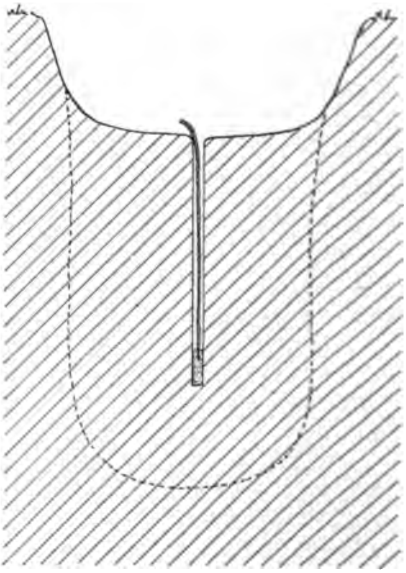
SOIL AUGER BIT
For making or deepening bore holes, it is necessary to have the auger strong and heavy.

The use of a soil auger is often required for finishing the bottoms of very deep holes where churn drilling or punching is difficult.

Holes can be made entirely by the use of the auger, but this is usually more expensive than punching. When the soil is too dry to stick to the auger, a little water should be poured into the hole. This forms mud that can be easily lifted out.

Hard shale and rock require the use of rock drills.

Loading.—Shallow holes are ordinarily blasted by using a half, or, if the ground is very hard, a whole cartridge of Red Cross Farm Powder, Du Pont Quarry Powder, Red Cross Stumping Powder or 20 per cent. to 40 per cent. Red Cross Extra Dynamite. This is primed and loaded in the bottom of the bore hole, usually without tamping. (See heading, "Making a Primer," on page 9.) Either blasting and fuse, or electric blasting caps may be used.



LOADING FOR A SHALLOW HOLE
The primer is placed in the bottom and no tamping is used.

The effect of such a blast is to force back the soil and form a "pot hole" at the bottom, and loosen the soil above so that it may be easily spooned out. This avoids the necessity for using a chisel or other tool to loosen the hard ground.

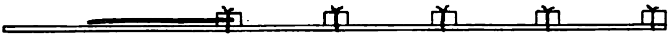
The greater part of the ground is packed back into the wall and bottom, especially if it is wet or moist when the blasting is done. Some loose soil is usually left at the bottom of the hole.

Blasting Deep Holes in Hard Ground

The method of loading must be changed for deep holes, or else a tight bridge or plug of dirt will be left at the top. To prevent this, the charge must be distributed along the hole.

This distribution may be made in three different ways.

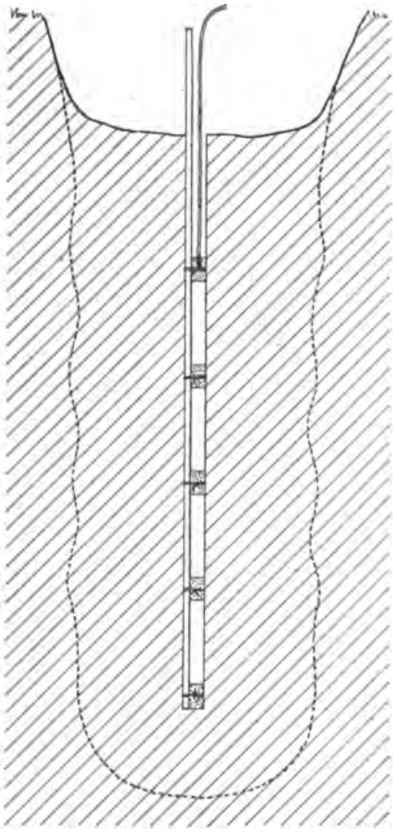
Method A.—Use a straight, narrow lath, reed, or stick, as long as the hole is to be deep. Cut the cartridges into two or three pieces.



DYNAMITE CHARGES TIED TO STICK AND READY TO LOAD FOR A POLE HOLE BLAST

The amount of dynamite in each charge must be governed by the strength of the dynamite and by the hardness of the ground.

Tie one piece of dynamite to the side of the stick at one end, from 6 to 10 inches further up tie a second piece. Continue this to within 12 to 18 inches of the top, where a half cartridge primer (see paragraph "Making a Primer") is used.

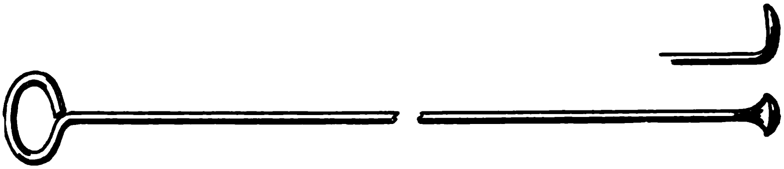


Loading a deep hole by Method "A," showing the relative positions of the charges and primer tied to the lath. Dotted line indicates size and shape of the blasted hole.

The charge thus arranged is placed, with the primer end up, into the hole, and fired. Tamping is seldom required.

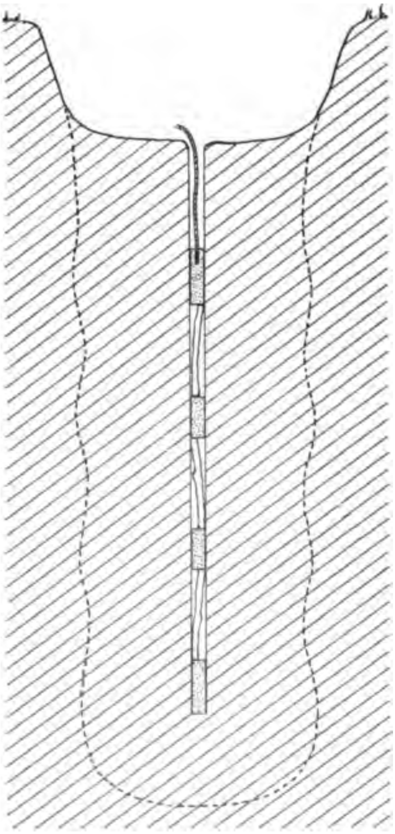
Method B.—Space the pieces of cartridge as has been described, on the edge of a sheet of heavy wrapping paper, with the primer at one end. Roll into a long cylinder or rod, and fasten the dynamite with pins stuck through from the outside. This method is not generally considered so satisfactory as method "A," as the paper cylinders may be hard to make, or may give trouble in the wind. The loaded cylinder is placed in the hole in exactly the same manner as the charge tied to a lath.

Method C.—When neither straight laths nor wrapping paper are obtainable, good loading can be accomplished by dropping the desired fraction of a cartridge to the bottom of the hole. On this drop and press into place with the tamping stick, one or more small sticks or strong weeds broken to the length to which it is desirable to space the next charge. Place the second charge and repeat, using more short sticks, until the primer is needed. The sticks must not be large enough to fill the hole.



SPOON FOR CLEANING OUT BORE HOLE
This can be made of ⅜-inch or ½-inch round steel

Care must be exercised to see that the sticks do not slip past the dynamite and that the dynamite rests on the top of the stick.



Loading a deep hole by Method "C," showing the location of the dynamite, sticks and primer. Dotted line indicates shape of blasted holes.

This method can often be used to good advantage in isolated places where the material for the other methods is hard to obtain.

No matter which method is used, care must be exercised to see that the space between the charges is not plugged up, as the lower charges are exploded by the shock of the top charge or primer. The presence of a plug or of tamping between the charges may be sufficient to blanket off this shock and leave the bottom charges unexploded.

The explosive recommended is Red Cross Extra, 40 per cent. or stronger. In warm weather Du Pont Straight, 40 per cent. or stronger, is used to good advantage, as the charges can be spaced further apart, and there is a reduction in the slight danger of misfires and unexploded charges.

The top or soft ground should be shoveled out before blasting. as was recommended for shallow holes. This assists in confining the blast to the desired area.

Reports on Blasts for Deep Holes

In a hard clay soil, an effort was made to blast 4½-foot pole holes. The bore holes were made with an auger. The paper cylinder method was used. The top was shoveled out before loading.

Hole No. 1.—Half cartridge of Du Pont Straight 60 per cent. in bottom of hole, halt cartridge Red Cross 40 per cent., 2 feet from top. Cap in top cartridge, untamped. Results: Poor; hole not sufficiently opened up at top and earth fell in, filling up the hole.

Hole No. 2.—One-third cartridge Du Pont Straight 60 per cent. in bottom; one-third cartridge Du Pont Straight 60 per cent., 8 inches from bottom; half cartridge Red Cross 40 per cent., 20 inches below surface. Cap in top charge, untamped. Results: Good; hole clean and open.

Hole No. 3.—One-third cartridge Du Pont Straight 60 per cent. at bottom, same 12 inches up. Same 12 inches further up, cap in top cartridge, untamped. Results: Same as No. 2 except more earth thrown out of hole.

Hole No. 4.—Five quarter cartridges Du Pont Straight 60 per cent. evenly distributed about 6 inches apart, beginning at bottom hole, untamped, cap at top. Results: Good; hole uniform in size top and bottom, and dirt blown out.

Hole No. 5.—Four quarter cartridges Red Cross 40 per cent. distributed same as No. 4. Results: Good; same as No. 7; not quite so much dirt blown out.

Hole No. 6.—One and a quarter cartridges Du Pont Straight 40 per cent. in small pieces in paper tube. Pieces about 4 inches apart beginning at bottom to within 14 inches of surface. Results: Excellent hole, clear of dirt.

Hole No. 7.—In hard clay troubled with shale, Red Cross Extra 40 per cent. Five feet deep. Charged from bottom to top with 1, ½, 1, ½, ½ cartridge charges, spaced 8 inches apart. Excellent hole.

TAMPING STICK
Only a wooden tamping stick should be used for loading and tamping holes.
One can be made from the handle of a shovel.

FIRING.—May be by means of blasting caps and fuse, or by electric blasting caps. When fuse is used it should always be cut long enough to give the blaster time to retire to a safe distance. If electric firing is practiced, the leading wire should be long enough to keep the blaster well away from the shot.

SPOON SHOVEL WITH LONG HANDLE

CLEANING OUT HOLES.—An ordinary post-hole digger or a spoon shovel is desirable for removing the loose earth. No digging bars are necessary, the earth being well broken. The average time for cleaning the hole to receive the pole is 5 to 10 minutes.

COSTS.—Taking the cost of a hole by hand digging at 50 cents, a fair average, blasting these holes would cost as follows:

	Hole No. 4	Hole No. 5
For Dynamite and Caps	13 $\frac{1}{16}$ cents	9½ cents
Fuse and Matches	1 "	1 "
For Labor	14 "	14 "
For Supervision	3 "	3 "
Total Cost	31 $\frac{1}{16}$ "	27½ "

NUMBER OF HOLES PER DAY.—The total number of holes per day will be greatly increased when dynamite is used. The labor is much less, and the poles may be more firmly set, as the earth about the hole is packed by the explosion, thereby reducing the amount of tamping necessary when the pole is set. Thus indirectly a considerable saving is effected.

GANG WORK.—Less men are required when dynamite is used. The gang may be made up as follows:

Wagon with tools and dynamite;
Two diggers;
One man with flags and dynamite;
One digger to trim up hole;
One man with fuse and blasting caps.

These are followed by the regular pole-raising gang, or they go back and set poles after shooting a given stretch of holes.

BLASTING THE POLE HOLE

The long cartridges are preferably made near where they are to be used, and should not be made up in large amounts as changes in the soil may necessitate changes in the quantity of dynamite used. All precautions should be exercised in shipping, hauling and handling the explosives and supplies used.

The diggers make the holes.

Two holes behind the diggers comes the "loader," who puts the cartridge in the hole, and places a red flag on top of same.

One hole behind the "loader" comes the "shooter."

Every ten holes the "loader" may recover the ten flags taken up by the "shooter."

While it is possible for one man to load and shoot, this is not advisable.

A rule should be that four men comprising the gang should not get out of sight of each other. Such a gang will complete from thirty to fifty holes a day—say a mile of poles per day of 10 hours.

Summary of Results

The dynamite method is not only easier than hand digging, but actually costs less. There is practically no danger. Greater progress can be made with the line, especially in hard soils. In the majority of cases, one cartridge of 40 per cent. Straight Dynamite will do the work.

As the average telephone man is not familiar with handling explosives, clear instructions of a general nature, particularly as to cutting the cartridges, putting in fuse, and loading, should be given by the foreman.

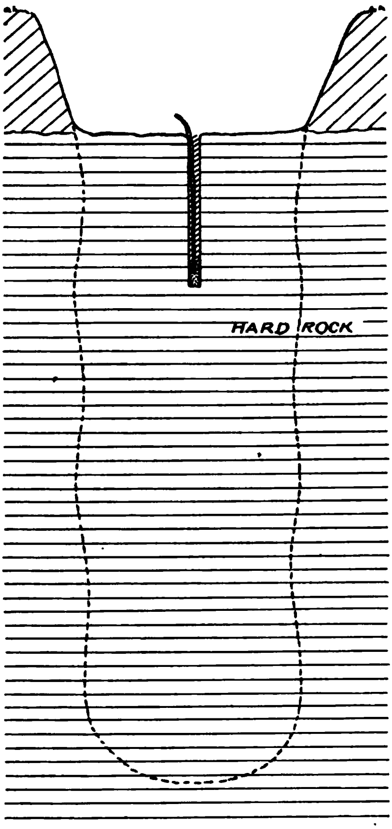
A construction crew who once employs the dynamite method will become an enthusiastic advocate of it and will not readily return to the hand method.

Blasting Deep Holes in Rotten Shale

For blasting holes in rotten shale and similar material, the method of loading and the explosives suggested are useful, the only material variation being that heavier loading will be required. It is often advisable to tamp the top of the hole. The top charge or primer should not be too heavy as a heavy blast at the surface has a tendency to blow out a decided crater. Often a full cartridge of 60 per cent. strength dynamite will be needed at the bottom.

Blasting Holes in Solid Rock

As it is impossible to force back the sides of the holes in solid rock, as is done in blasting in hard clays, modifications in the method



In hard rock the bore hole must not be deep. After the first blast clean out the fragments and drill a second hole. Dotted line indicates the shape of the blasted hole.

of loading are required. Ordinarily holes are not put down so deep in rock as in hard ground.

After excavating the hole down through the soil, if any is present, drill a hole from 12 to 18 inches into the rock. Load this with a full cartridge primer pressed well to the bottom, tamp the hole tight, and fire.

If the loading is heavy enough this will shatter the rock to the full depth of the blast. When the loose fragments have been removed, drill another hole to about the same depth and load as before.

The explosive used for this work should never be of a lower strength than Red Cross Extra 40 per cent. strength, and for hard rock 50 or 60 per cent. strength is often better.

Digging Holes for Tower Foundations

These same recommendations will be found equally pertinent to the digging of the holes for tower foundations, where towers are used instead of long poles.

After the blasting, the hole can be cleaned out and is then ready for pouring the concrete. The bottom of the hole is usually left in a good, firm condition.

Tamping Poles in Blasted Holes

When the blasting is properly done, and the hole cleaned out, the pole may be erected and tamped in the usual manner. Good blasting does not injure the sides of the holes in such a manner as to cause trouble from leaning poles.

Use a Minimum of Dynamite

As excessively heavy charges are apt to blow out too large a hole, or injure the side of the hole so that good tamping is impossible, use only enough dynamite to do the required work.

Watch the progress of the blasting and increase or decrease the charges as the nature of the ground varies.

Making a Primer With Blasting Cap and Fuse

The act of placing the detonator in the charge is known as priming and the cartridge of explosive with the detonator in it is called a "primer."

In the preparation of the primer, when using fuse and blasting cap, examine your dynamite and see that it is not frozen. Frozen dynamite is hard and rigid, and dangerous to handle; when thawed it is soft. Next examine your fuse. Cut off and discard an inch or two from the end of the coil as it may have attracted moisture from the air. See that the fuse is not stiff and brittle; if in this condition it is advisable to warm slightly and cut the required length from the roll with a sharp knife or pruning shears. The cut should be made squarely across and not diagonally.

Sometimes in the cutting the end becomes flattened, thereby making the end of the fuse too large to enter the blasting cap. When this happens squeeze the end round with index finger and thumb. Open the cap box and allow one blasting cap to slide gently into the open hand, but *under no circumstances pick a blasting cap out of the box with a piece of wire, stick, or other hard substance.* See that there is no grit or trash in the blasting cap. Slip the end of the fuse gently into the blasting cap until it is against the charge in the bottom. Do not twist the fuse as the friction might cause a premature explosion. Then take the Du Pont cap crimper and fasten the blasting cap to the fuse with a crimp close to the open end of the copper shell. These operations are not dangerous, but should be done carefully, as crimping the loaded end of the blasting cap would explode it. If the primer is to be used in a wet hole, smear a little hard tallow, soap or similar substance (not oil or thin grease) around the top of the blasting cap to insure against water leaking in and ruining the blasting cap before it is fired. The blasting cap is then ready to be inserted into the dynamite.

There are two reliable ways of doing this—in the side and in the end.

The Side Method of Priming with Fuse and Blasting Cap.—Punch a hole diagonally into the side of the cartridge, near the end and pointing toward the center to a sufficient depth to receive the entire blasting cap. Insert the blasting cap crimped on the fuse and tie it there with a piece of cord. This method has the advantage of leaving a good place to apply the tamping stick in seating the primer in the hole. (See Plate A.) It is not feasible for loading pieces of a cartridge shorter than a half cartridge.

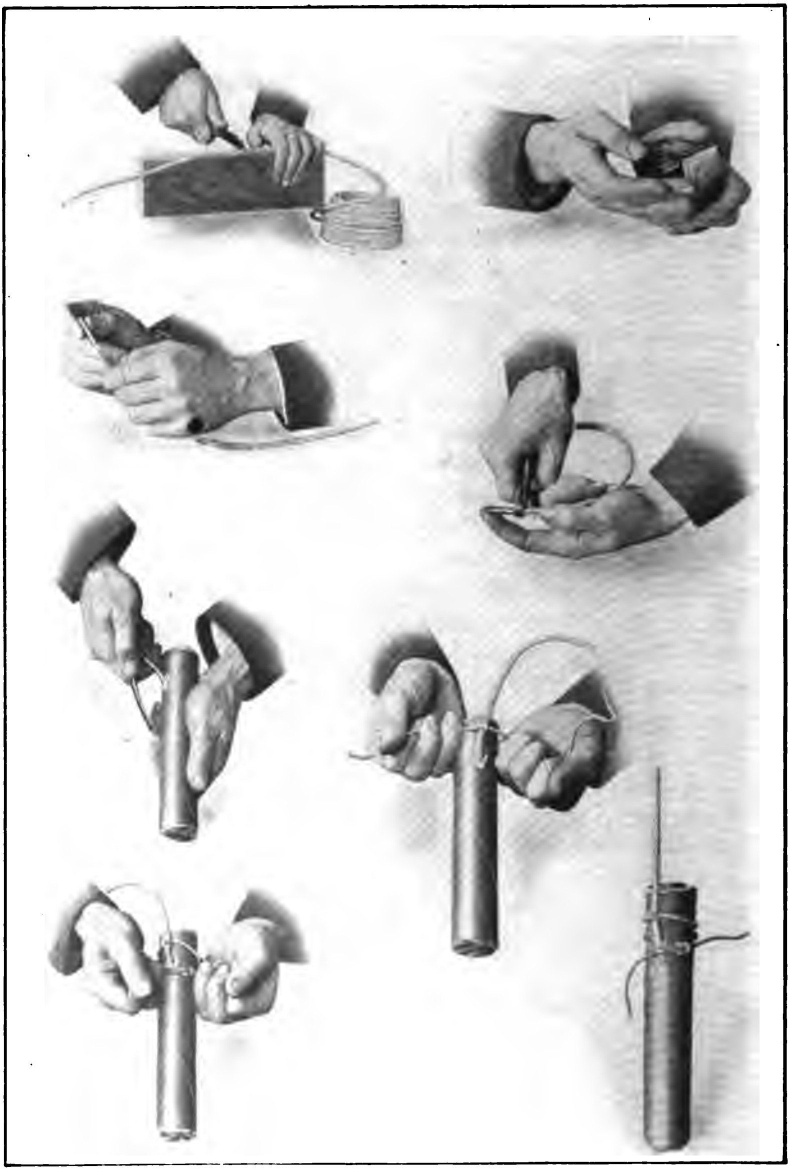


PLATE A

METHOD OF PRIMING IN THE SIDE WITH BLASTING CAP AND FUSE

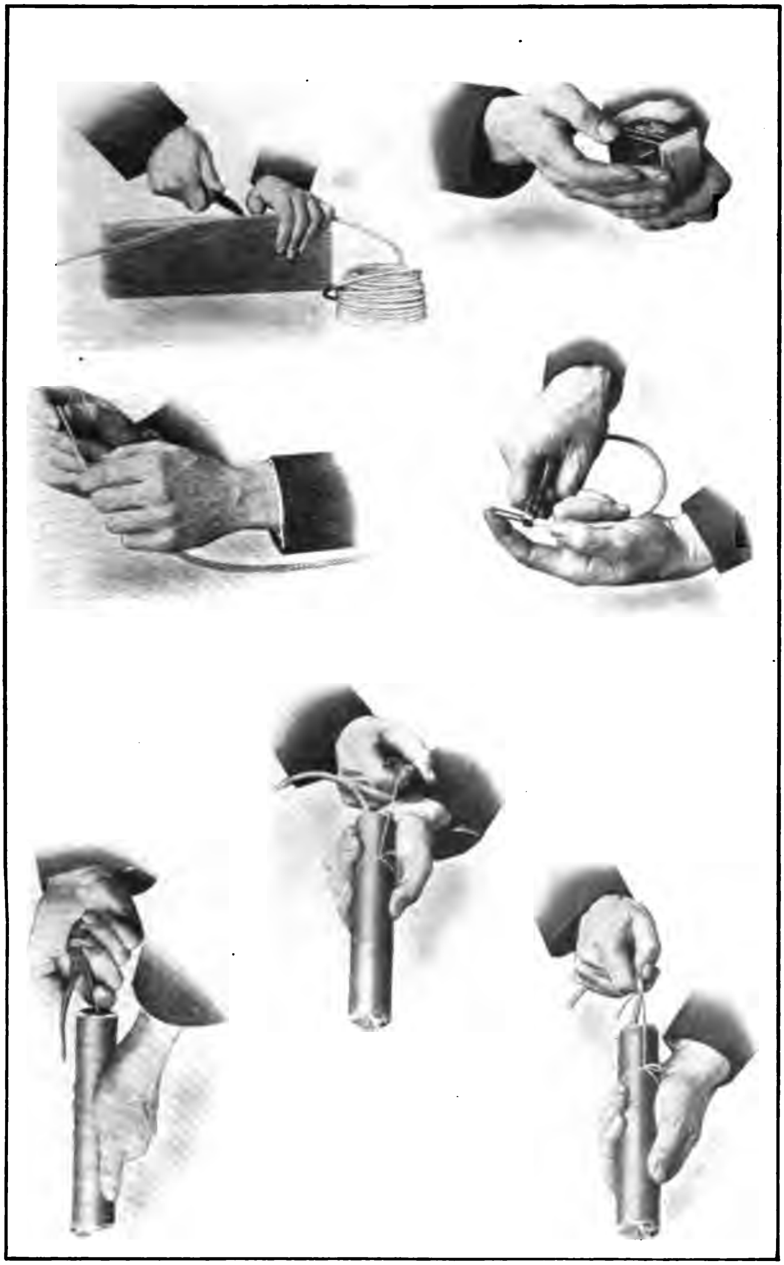


PLATE B

METHOD OF PRIMING IN THE END WITH BLASTING CAP AND FUSE

The End Method of Priming with Fuse and Blasting Cap.—Crimp the blasting cap to fuse as before. Punch hole in end of the dynamite cartridge. Insert the blasting cap crimped to fuse. Tie one end of a piece of string around the dynamite cartridge, about 2 inches from the end, firmly, so that it will not slip. Tie other end of string to the fuse, about 1 inch above dynamite cartridge. The strain of the fuse will now come on the string which, if tied tightly at both ends, will not allow the blasting cap to pull out. (See Plate B.) Do not prime a cartridge before cutting it into short pieces, as the knife might cut into the blasting cap and explode the charge. Do not lace the fuse through the cartridge.

Priming with Electric Blasting Cap.—Either of the above methods may be used for priming with electric blasting caps, making sure that the string is tied to the wires so that it will not slip. Never half-hitch the wires around the cartridge.

The holes can be punched in the dynamite with the handle of the cap crimper, or with a wooden awl, and should always be deep enough to receive the entire blasting cap.

When the primer is to be of only half a cartridge, punch a hole in each end of the cartridge and cut the cartridge in two *before* inserting the blasting caps.

CUTTING CARTRIDGE IN HALF

Cutting a Dynamite Cartridge in Half

When small charges are desired it becomes necessary to cut cartridges. This should be done with a sharp knife. Hold the cartridge firmly in one hand and the knife in the other. Giving the cartridge a rotary motion, cut the paper all the way around and then bend the cartridge slightly, when it will come apart just where the paper is cut. Never try to cut a frozen cartridge, nor a primed cartridge.

Thawing

Frozen dynamite is easily recognized because it is hard and rigid. The best way to thaw dynamite, and to keep it thawed until it is to be used, is in a thawing kettle made for the purpose. It may be thawed by leaving it spread out on a shelf in a warm room (not in a dwelling) over night, or by burying it, while in the case, in green manure. It may also be thawed by putting it in a covered, water-tight pail and hanging this pail in warm water and it may be carried to the work in a dry box if covered with an old coat, a piece of blanket or something of the kind to keep it warm. It is exceedingly dangerous to try to thaw dynamite in front of an open fire, or in hot sand, or ashes, or on hot stones, or metal or steam pipes, or in an oven, and it is in attempting to thaw dynamite in some of these ways that accidents frequently happen. Do not attempt to thaw dynamite by putting the cartridges in hot water or by turning a jet of steam on it.

DU PONT THAWING KETTLE

The Du Pont Thawing Kettle is made in one piece with an outside jacket for the hot water. The No. 1 size holds 30 pounds of dynamite and No. 2 size 60 pounds.

The water must never be heated in the kettle, but must be heated in some other vessel, and when not too hot to burn the hand, poured into the water compartment when the dynamite compartment is empty. It is dangerous to heat the water in the Du Pont Kettle even when the dynamite section is empty, because there may be a little nitroglycerin in it which has soaked out of the dynamite previously thawed. Dynamite should not be put into the thawing kettles without first carefully wiping out the dynamite compartment clean and dry.

Do not place a thawing kettle over a fire while it contains dynamite.

CASE OF RED CROSS EXTRA DYNAMITE

Explosives and Blasting Supplies Required for Blasting Pole and Post Holes

Dynamite is packed in cases containing 25 or 50 pounds net weight. The cartridges are 1¼ inches diameter by 8 inches long and weigh about eight ounces each. Cartridges are marked with the brand of dynamite, and the trade mark of the Du Pont Company.

INSTRUCTIONS GOVERNING THE USE OF EXPLOSIVES

These instructions cover the more important precautions that should be taken to avoid accidents and insure safety in the use and handling of explosives, with special reference to dynamite and blasting supplies. They must always be handled carefully.

1. Handling Dynamite. No one except a properly qualified employee, known as a Powder Man, should be allowed to use or handle dynamite or blasting supplies.

The Powder Man should be able to read and write the English language. It would be well for him to read Bulletin No. 17, issued by the U. S. Bureau of Mines, entitled "A Primer on Explosives for Coal Miners."

2. Portable Magazines. It is well to convey the explosives from the main magazine to the piece of work in a portable magazine, consisting of a strong but light wooden box with the inside dimensions of 15½ inches long by 9 inches wide by 8 inches high, provided with handles and a cover that can be locked. The material for this magazine should be not less than ½ inch in thickness when finished. The capacity is approximately 25 pounds. The cartridges should never stand on end, but should be laid flat in the magazine. The inside of the box should be free from the exposure of nails, screws or metal of any kind. The magazine should be painted a bright red and the word "Dynamite" plainly painted in black letters on the two ends and the front and back of the magazine.

In case the magazine becomes stained with the nitroglycerin, scrub well with a hard brush and a solution composed of one quart wood alcohol and one-quarter pound sulphide of sodium or sulphide of potassium. Use plenty of the liquid so as to thoroughly decompose the nitroglycerin.

The box should be lined with paper saturated with paraffine or other material impervious to liquid nitroglycerin. Each time the box is refilled with dynamite, it should be relined.

When placing the cartridges in the magazine, the bottom of same should be covered with about ½ inch of sawdust, then the cartridges of dynamite packed thereon, covered by another layer of sawdust, so that the cartridges are approximately ¼ inch apart. If the sawdust shows any signs of leakage of nitroglycerin, it should be destroyed and new sawdust used for repacking.

3. Storage of Dynamite. All dynamite, when not being used, should be stored in a safe, dry and well ventilated magazine. It should be kept under lock and key, in charge of an authorized employee (Powder Man), who will be responsible for its care.

Under no circumstances should gunpowder, blasting powder, railroad fuses, railway torpedoes, electric blasting caps, blasting caps, or other explosives be stored in the same building with dynamite.

Blasting caps or electric blasting caps, when not in use, should be stored in a separate building, which is dry and well ventilated.

4. Transporting Dynamite. When transporting dynamite by train, the instructions issued by the Bureau for the Safe Transportation of Explosives should be strictly complied with. Copies of these instructions can be obtained by making requisition on the Bureau, whose address is New York City, N. Y. Explosives or blasting supplies of any character whatever should never be transported on a passenger train under penalty of a very heavy fine and imprisonment.

When necessary to transport dynamite by wagon, the wagon should be in good condition and equipped with springs. The wagon box should be free from the exposure of any nails, bolts, screws, or metal of any kind.

Dynamite should not be transported in the same wagon with blasting caps, electric blasting caps, metal tools or any inflammable material.

No explosives should be left in a wagon unless the wagon is in charge of an authorized Powder Man.

5. Danger of Lighted Pipes, Cigars, Matches, Etc. Parties handling explosives should not smoke, nor light matches, nor carry matches, or other combustible material while handling dynamite or blasting supplies. Nor should they carry, nor deposit either at or near blacksmith shops or other places where there are fires or flying sparks.

Never carry electric blasting caps, blasting caps or dynamite in the pocket.

Never carry electric blasting caps, blasting caps or dynamite at the same time. If necessary to move them both any distance, make separate trips.

6. Opening Box Containing Dynamite. The only tools necessary for opening boxes containing dynamite are a wooden wedge and a wooden mallet. Never use a nail puller. A screwdriver may be used only for removing screws.

DU PONT

EXPLOSIVES
For Quarry Blasting

PRACTICAL INFORMATION RELATING TO THE SELECTION OF EXPLOSIVES AND METHODS OF APPLICATION TO ASSURE THE MOST SATISFACTORY RESULTS

1802 1915

MANUFACTURED BY
E. I. DU PONT DE NEMOURS AND COMPANY
WILMINGTON - DELAWARE

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AND COMPANY
WILMINGTON, DELAWARE

DU PONT

EXPLOSIVES

For Quarry Blasting

PRACTICAL INFORMATION RELATING TO
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DU PONT

MANUFACTURED BY
E. I. DU PONT DE NEMOURS
AND COMPANY
POWDER MAKERS SINCE 1802
WILMINGTON, DELAWARE

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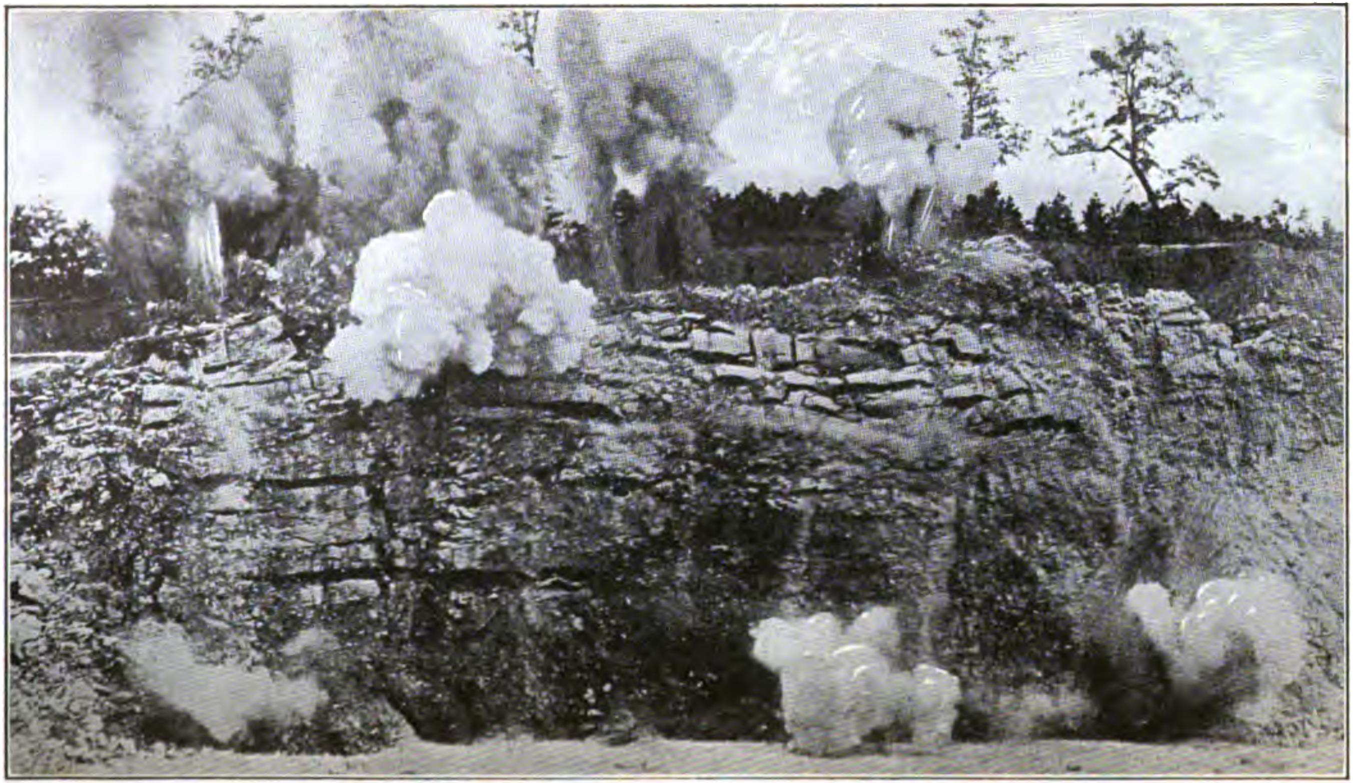


BLASTING DOWN THE FACE OF A QUARRY IN ALABAMA

DU PONT

EXPLOSIVES

FOR QUARRY BLASTING

THE cost of blasting in quarries is very largely dependent upon the explosive selected, and the method of using it.

In order to properly select an explosive to insure lowest cost of production, it is necessary to consider the conditions attending its use. These are classified as follows:

Quality of Stone.—Hard or soft; tough or brittle; cleavage and stratification, distinct or indistinct.

Condition of Stone.—Solid or fissured; compact or loose; stratification, horizontal, vertical, pitching or dipping.

Purpose for Which Stone is Used:

Large Size:	Small Size:
Dimension stone,	Stone and ore for crushers,
Blocks,	Furnace,
Stone for fills,	Kilns and ballast.
Rip-raps and cribbing.	

Kind of Bore Hole.—Well drill—deep, large diameter; hammer drill—shallow—vertical or down holes; horizontal or snake holes; blasting by means of small tunnels.

General Quarry Conditions.—Height and length of face; relation of face to cleavage planes; wet or dry; distance from buildings, railroads or highways; thawing facilities.

Labor Conditions.—High or low class; scarce or plenty; high or low wages.

The different combinations of the above conditions are met by selecting the explosive having those properties best suited to the conditions, and by using that explosive in the most effective way.

THE PROPERTIES OF EXPLOSIVES

The properties of explosives which should be given attention are:

Strength,
Quickness,
Density,
Water Resistance,
Cold Resistance.

Strength of Explosives.—If the explosive is too strong, reducing the charge may prove effective, but the proper step is to secure a weaker explosive. When the charge is reduced, it does not rise as high in the bore hole and the upper stone may not be properly broken.

SELECTING THE PROPER EXPLOSIVE

From the foregoing explanation of the characteristics of explosives, the quarryman is now in position to give attention to the selection of an explosive most suitable for his quarries.

The following list gives the names of brands of Du Pont explosives and the properties of each:

Red Cross Straight

Strength from 25 per cent. to 60 per cent.;

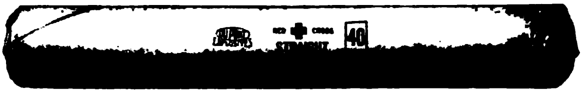
Higher Grades: Very quick and shattering;

Lower Grades: Moderately quick and shattering;

Density: Averages 105, 1¼ in. x 8 in. cartridges, per 50 pounds, with 5 per cent. variation either way;

Will rarely freeze in the coldest weather; will remain under water a few hours without deteriorating.

Case of Red Cross Straight Dynamite



Cartridge of Red Cross Straight Dynamite

Red Cross Extra

Strength: 20 per cent. to 60 per cent.; a little slower than Red Cross Straight—more spreading effect;

Density: Averages 102, 1¼ in. x 8 in. cartridges per 50 pounds, with 5 per cent. variation either way;

Will rarely freeze in the coldest weather;

Will not deteriorate after a few hours under water if cartridge shells are not cut or broken. Will stand water for a short time even when the cartridge shells are cut or broken.

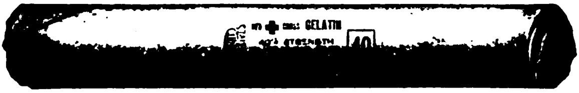
Case of Red Cross Extra Dynamite

Cartridge of Red Cross Extra Dynamite

Red Cross Gelatin

Strength: 40 per cent. to 90 per cent.;
Moderately slow;
Density: Averages 87, 1¼ in. x 8 in. cartridges per 50 pounds, with 5 per cent. variation either way;
Will rarely freeze in the coldest weather;
Slightly affected by water.

Case of Red Cross Gelatin Dynamite

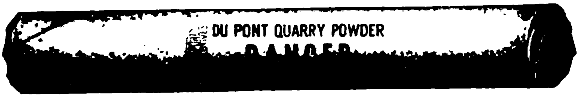


Cartridge of Red Cross Gelatin Dynamite

Du Pont Quarry Powder

One strength only;
About equal to Red Cross Straight 40 per cent. strength in quickness;
Density: Averages 105, 1¼ in. x 8 in. cartridges per 50 pounds, with 5 per cent. variation either way;
Will rarely freeze in the coldest weather;
Will remain under water a few hours without deteriorating.

Case of Du Pont Quarry Powder



Cartridge of Du Pont Quarry Powder

Du Pont, Repauno, Forcite and Forcite Special Gelatin

Strength: 35 per cent. to 75 per cent.;
Moderately slow;
Density: Averages 88, 1¼ in. x 8 in. cartridges per 50 pounds, with 5 per cent. variation either way;
Will rarely freeze in the coldest weather;
Not affected by water.

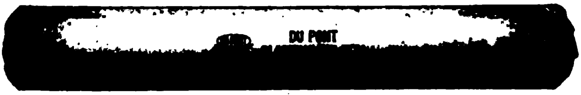
Case of Du Pont Gelatin Dynamite

Cartridge of Du Pont Gelatin Dynamite

Du Pont Blasting Gelatin

Case of Du Pont Blasting Gelatin

- One strength only: 100 per cent.—the strongest blasting explosive;
- The quickest and most shattering explosive manufactured;
- Density: Averages 88, 1¼ in. x 8 in. cartridges per 50 pounds, with 5 per cent. variation either way;
- Freezes at 45° F. to 50° F. and must be thawed before using;
- Not affected by water.



Cartridge of Du Pont Blasting Gelatin

Du Pont Straight

Has the same properties as Red Cross Straight except that they freeze at 45° F. to 50° F. and must be thawed before using.

Du Pont Extra

Has the same properties as Red Cross Extra except that they freeze at 45° F. to 50° F. and must be thawed before using.

Du Pont R. R. P.

The weakest and slowest high explosive—ranks between blasting powder and dynamite—granular, packed in bulk in four 12½-pound paper bags in 50-pound wooden cases.

DU PONT R. R. P.
12½ Lbs.
12½ Lbs.
FOR
RAILROAD and QUARRY WORK
INSTRUCTIONS FOR USE:
Always explode Du Pont R. R. P. with a cartridge of Red Cross or Du Pont Dynamite, and see that the cartridge is well buried in Du Pont R. R. P.
Never attempt to explode Du Pont R. R. P. with fuse alone, as it will not explode but will burn.
MANUFACTURED BY
E. I. du Pont de Nemours Powder Company
WILMINGTON, DELAWARE
U. S. A.

12½ Pound Bag of Du Pont R. R. P.

- Very bulky.
- Will rarely freeze in the coldest weather, but explodes properly when frozen if the lumps are crumbled. A 40 per cent. or stronger Red Cross Straight, or Du Pont Straight, primer is necessary to explode it with best results.
- Resists water better than blasting powder, but should not be used in wet work.

"A" and "B" Blasting Powder

"A" Blasting Powder is quicker than "B" Blasting Powder.

It is weaker and slower than high explosives, and the fine granulation is quicker than coarse granulation. It causes a lifting and heaving —not shattering—effect, and is a little denser than Du Pont R. R. P. "A" Blasting Powder is not affected by cold. It cannot be used in wet work. It is damaged by moisture and dampness, but "A" Blasting Powder resists moisture a little better than "B" Blasting Powder.

General Summary

To shatter and throw very hard, tough stone: Red Cross Straight or Du Pont Straight 40 per cent. to 60 per cent.

For medium hard stone: Lower strengths, or Du Pont Quarry Powder.

To turn out hard, tough stone: Red Cross Extra or Du Pont Extra 40 per cent. to 60 per cent.

For medium hard stone: Lower strengths.

For soft, shaly stone or dimension stone: Blasting Powder or Du Pont R. R. P. with air spaces (Knox System).

For very wet work: Gelatin, or Blasting Gelatin.

In cold weather: Red Cross Straight, Red Cross Extra, all Gelatins (except Blasting Gelatin), Du Pont R. R. P., Du Pont Quarry Powder and Blasting Powder.

Tamping

Unless a bore hole is compactly tamped to the mouth with damp clay or a similar material, a part of the strength of the explosive is generally wasted.

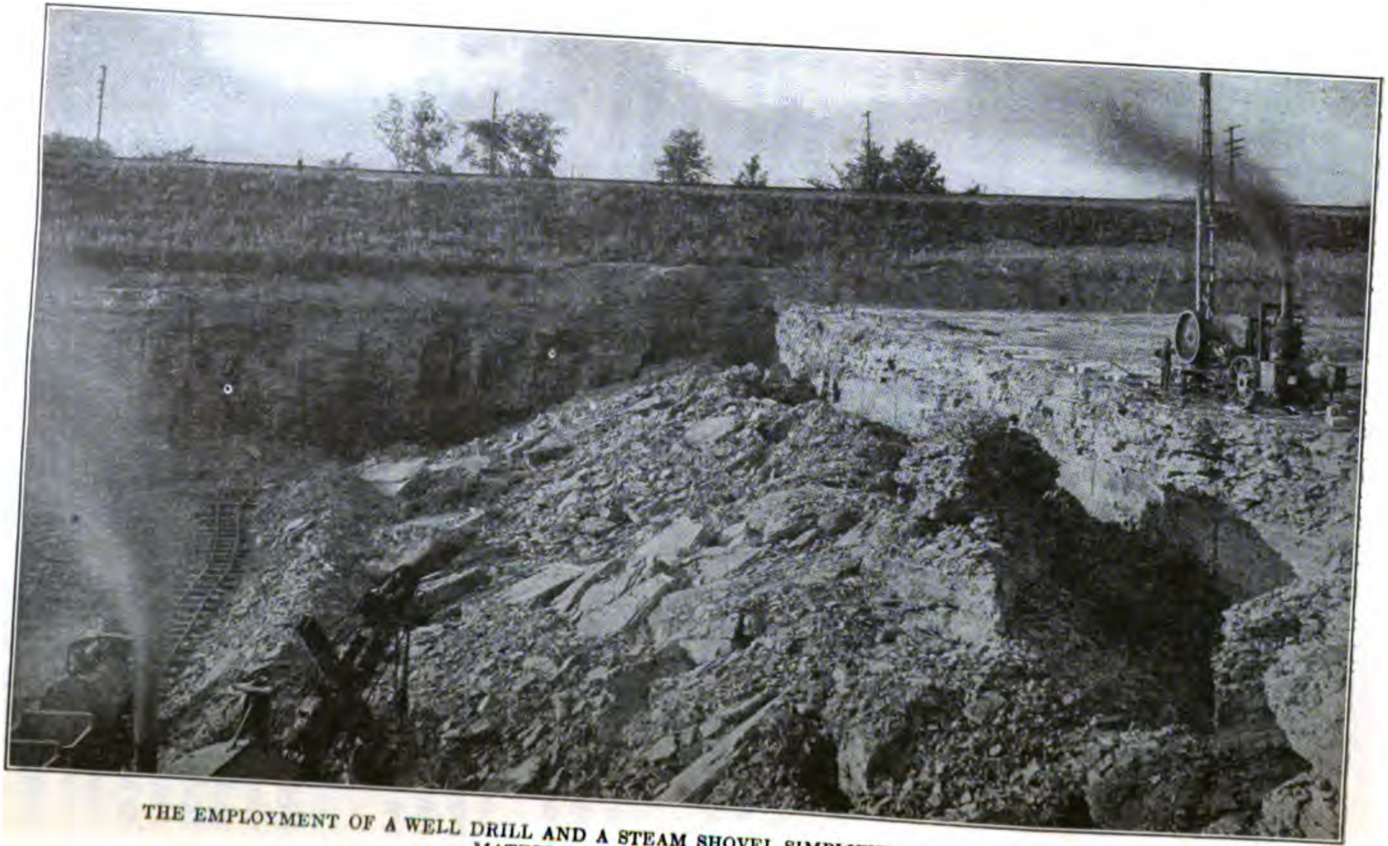
Priming

Blasting powder is ignited with fuse, an electric squib or a dynamite primer; Du Pont R. R. P. is exploded with a dynamite primer. All other explosives are detonated by a No. 6 (Red Label) or stronger blasting cap or electric blasting cap.

MORE PROFIT FOR THE QUARRY

Owners of limestone quarries should remember that ground limestone and lime are valuable soil amendments, and that their use on many farms has brought about a great increase in the crops. In the profitable "intensive" farming carried on by all up-to-date agriculturists, every square yard of ground is made to produce the largest possible quantity of grain, fruits or vegetables. This requires constant attention to soil treatment and cultivation, and increases the demand for ground limestone, or quicklime, for soil improvements.

A number of quarrymen have entered this field and they are finding it one which can be further developed at a profit to themselves, as well as to greatly improve the fertility of soil in their community.



THE EMPLOYMENT OF A WELL DRILL AND A STEAM SHOVEL SIMPLIFIES THE METHOD OF OBTAINING MATERIAL FOR CRUSHERS AND KILNS

THE ADVANTAGES DERIVED FROM THE WELL DRILL IN QUARRY OPERATIONS

It is only a few years since the advent of the well drill in quarry operations. Its use has increased by leaps and bounds and daily quarry operators are adopting it. No one nowadays questions the success of the big drill and its superiority over the air or steam drill of tripod type.

Universal interest has been created by the automobile in good roads. This, with the tremendous increase of steel and concrete in building and engineering operations, has caused a great demand for crushed stone for road mineral, cement manufacture, lime making and blast furnace flux, etc.

The well drill, along with the big crushers and the steam shovel, has been an important factor in making it possible to supply this demand. The introduction of big machinery has revolutionized quarrying and other rock excavating operations.

The well drill is proving more economical, efficient and convenient than the old type of drill. It is best suited where the stratification of the rock permits and the height of the face is more than 25 feet.

It has been found from observation that the cost of drilling bore holes with the ordinary tripod drills varies from 10 cents to 25 cents per foot. This wide variation of cost depends on the character of the rock, cost of labor, fuel, oil, etc., number of drills in operation and the accessibility to source of power, water, etc. The fewer the drills in operation, if run from a central power plant, the higher will be the cost per foot.

In rocks of medium hardness, such as limestone, a man working industriously should average from 40 to 60 feet of bore hole per ten-hour day. The cost of drilling such rocks will seldom fall below 15 cents per foot, in a quarry operating several drills. In harder rocks, such as traps, syenites, granites, etc., from 20 to 30 feet is an average day's work, and the cost will be from 20 cents to 25 cents per foot.

The cost of drilling a 5⅝-inch bore hole with a well drill may vary all the way from 20 cents to 60 cents per foot. In several operations the cost per foot is less than 30 cents. A good operator and helper in ordinary limestone, where strata are flat and other conditions favorable, can make from 20 to 60 feet per ten-hour day.

In very hard rocks, such as traps, granites, etc., from 15 to 25 feet a day should be considered a fair day's work.

It is fair to assume 25 feet per day and 30 cents per foot as an average cost for well drilling.

In the following table are given the number of cubic yards of rock displaced per foot of bore hole at different spacings.

TABLE SHOWING THE NUMBER OF CUBIC YARDS OF ROCK DISPLACED PER FOOT OF BORE HOLE AT DIFFERENT SPACINGS

DISTANCE OF BORE HOLES BACK FROM FACE	DISTANCE BETWEEN BORE HOLES															
	5 Ft.	6 Ft.	7 Ft.	8 Ft.	9 Ft.	10 Ft.	11 Ft.	12 Ft.	13 Ft.	14 Ft.	15 Ft.	16 Ft.	17 Ft.	18 Ft.	19 Ft.	20 Ft.
5	.92	1.11	1.3	1.49	1.66	1.85	2.04	2.22	.....	.....	.....	.....	.....	.....	.....	.....
6	1.11	1.33	1.55	1.77	2.0	2.22	2.44	2.65	.....	.....	.....	.....	.....	.....	.....	.....
7	1.3	1.55	1.81	2.0	2.33	2.7	2.85	3.11	.....	.....	.....	.....	.....	.....	.....	.....
8	1.49	1.77	2.0	2.37	2.65	2.96	3.26	3.55	.....	.....	.....	.....	.....	.....	.....	.....
9	1.66	2.0	2.33	2.65	3.0	3.33	3.66	4.0	.....	.....	.....	.....	.....	.....	.....	.....
10	1.85	2.22	2.7	2.96	3.33	3.7	4.1	4.44	4.81	5.18	5.55	5.92	.....	.....	.....	.....
11	.....	.....	.....	3.26	3.66	4.1	4.48	4.88	5.3	5.7	6.11	6.52	.....	.....	.....	.....
12	.....	.....	.....	.....	4.0	4.44	4.88	5.33	5.77	6.22	6.66	7.11	.....	.....	.....	.....
13	.....	.....	.....	.....	.....	4.81	5.3	5.77	6.26	6.74	7.22	7.70	.....	.....	.....	.....
14	.....	.....	.....	.....	.....	5.18	5.7	6.22	6.74	7.26	7.77	8.30	.....	.....	.....	.....
15	.....	.....	.....	.....	.....	5.55	6.11	6.66	7.22	7.77	8.33	8.88	9.44	10.0	10.55	11.11
16	.....	.....	.....	.....	.....	.....	.....	7.11	7.70	8.30	8.88	9.48	10.07	10.66	11.3	11.85
17	.....	.....	.....	.....	.....	.....	.....	7.55	8.18	8.81	9.44	10.07	10.70	11.33	11.96	12.59
18	.....	.....	.....	.....	.....	.....	.....	8.0	8.66	9.33	10.0	10.66	11.33	12.0	12.66	13.33
19	.....	.....	.....	.....	.....	.....	.....	.....	9.15	9.85	10.55	11.3	11.96	12.66	13.37	14.07
20	.....	.....	.....	.....	.....	.....	.....	.....	9.63	10.37	11.11	11.85	12.59	13.33	14.07	14.81
21	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	11.66	12.44	13.22	14.37	14.77	15.55
22	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	12.22	13.03	13.85	14.66	15.48	16.30
23	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	12.78	13.63	14.48	15.33	16.18	17.03
24	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	13.33	14.22	15.11	16.0	16.88	17.77
25	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	13.88	14.81	15.74	16.66	17.60	18.51
26	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	14.44	15.74	16.37	17.33	18.30	19.26
27	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	15.0	16.15	17.0	18.0	19.0	20.0
28	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	15.55	16.6	17.63	18.52	19.7	20.74
29	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	16.1	17.18	18.26	19.33	20.4	21.48
30	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	16.66	17.77	18.88	20.0	21.1	22.22

To reduce to tons:

For limestone multiply by........2.27
For traps, syenites multiply by........2.52
For granites multiply by........2.8
For shale multiply by........2.18
For glass, sand or gravel multiply by........1.55

Relative Costs of Steam Drilling and Well Drilling

Assume for comparison 180 feet of drilling with each type of drill. The relative cost, assuming 15 cents per foot for steam drilling and 30 cents per foot for well drilling, would be:

Steam Drill:

Drilling 180 feet @ 15 cents = $27.00.
At 7 x 7 spacing = 1.81 cubic yards per foot.
Nine 20-foot holes = 180 feet × 1.81 = 325.8 cubic yards.
About 140 pounds of dynamite would be required.
140 pounds @ 12.5 cents per pound = $17.50.
Total cost: $27.00 + $17.50 = $44.50.
Cost per yard: $44.50 ÷ 325.8 cu. yds. = 13.6 cents per cu. yd.

An average cost when three 60-foot well-drill holes are blasted is about as follows:

Drilling: 180 feet @ 30 cents = $54.00.
At 20 x 20 spacing = 14.81 cubic yards per foot.
Three 60-foot holes = 180 feet × 14.81 = 2,665.8 cubic yards.
About 1,350 pounds of dynamite would be required.
1,350 pounds @ .125 cents per pound = $168.75.
Total cost: $168.75 + $54.00 = $222.75.
Cost per yard: $222.75 ÷ 2,665.8 cubic yards = 8.4 cents per cubic yard.

Labor Saving Effected by Use of Well Drill

The advantages of the well drill over the piston-driven drill are numerous. By carrying the bore holes the full depth of the face, the stone is loaded and treated on one working floor. It is unnecessary to employ a gang of men to bar down and clean off benches after the shot and to lift and lay tracks so frequently.

A quarry where 15 men had been used for this purpose, dispensed with them upon the adoption of the well drill.

Loading operations are less frequent, thus lessening the danger. Stone can be shot down in greater volume and in better shape, making it economical to use a steam shovel. No bench cleaning to do makes it safer for the men. It is cheaper and can be used in outlying and temporary operations where the cost of installing a power plant would be out of the question. It permits of a greater spacing of bore holes and eliminates necessity of "squibbing" or springing.

"Springing" Bore Holes Not Required

It is probable that the well drill will reduce quarry costs in this way more than by reducing the explosive cost per yard or ton blasted, the saving being shown in general quarry costs. In all blasting the object to be attained is maximum breakage at least cost. The greater the proportion of one-man-stone after a blast the better the shot.

In limestone quarries where stone is used for fluxing or lime making, spawls are practically waste. Too many fines are a serious obstacle in almost all stone operations, as the supply is greater than the demand. An ideal blast is one where the least amount of secondary drilling and blasting on the floor is required.

Production Costs Dependent on Careful Selection of Explosives

The question of the selection of explosives in obtaining the desired results is of great importance in quarry operations. Each superintendent should give the matter close attention. Explosive cost is one of the big items in the production of stone, and, generally speaking, little or no attention has been given to this important problem. It is worth while to consult an experienced engineer or explosive manufacturer if your cost is too high or results unsatisfactory.

The cost per pound of explosive is not necessarily the same as the explosive cost per yard of stone. A large operation producing limestone for furnace flux made a 25 per cent. saving in explosive cost mainly by changing method of the rock drilling and the handling of explosives.

All Explosives Are Not Alike

There are a great many explosives manufactured, nearly all of which differ in some way. Some are slow, others quick, some dense, others bulky. Conditions differ so much in actual practice, that the choice of the proper explosive for a certain class of work sometimes requires considerable patient labor and experimenting. Some explosives are especially adapted to hard, dense rocks and others to the lighter and seamy stratification. Some are suited to wet conditions and others only to dry conditions.

Low Freezing Explosives Recommended

During the last few years, low freezing Straight, Extra and Gelatin dynamites have been introduced. These explosives do not differ in action from the high freezing ones and are just as efficient. Ordinary dynamite freezes at about 45° to 50° F. Thawing explosives in winter is expensive, dangerous and tedious. The use of low freezing or non-freezing explosives will meet almost any condition and are strongly recommended.

Experienced Quarrymen Favor Large Bore Holes

It has been found by experience that it is just as cheap to drill a 5⅝-inch or 6-inch bore hole as one of smaller bore. The larger bore hole has the advantage of permitting a wider spacing and a better concentration of the explosives at the bottom, where it is usually most needed. It also requires the use of a heavier stem and drill bit, lending rigidity and steadiness to the machine and minimizing break-downs. Squibbing or springing well-drill bore holes is not recommended. It is a slow, tedious and expensive operation and is fraught with more or less danger. It is far better to reduce the spacing of bore holes than to resort to springing.

If the rock is very hard and the tow heavy or bottom hard to pull, oftentimes better results can be obtained by using an explosive of greater density, such as Gelatin, in the bottoms.

The following table gives the number of pounds of various explosives which can be loaded per foot in bore holes of different diameters, if the cartridges are slit and well tamped.

QUANTITY OF EXPLOSIVES WHICH CAN BE LOADED PER FOOT IN BORE HOLES OF DIFFERENT DIAMETERS.—CARTRIDGES SLIT AND HOLES WELL TAMPED.

Diameter of Hole. INCHES.	Du Pont or Red Cross Gelatin. LBS.	Du Pont Straight. LBS.	Red Cross Straight or Du Pont Quarry. LBS.	Red Cross Extra. LBS.	Du Pont Extra. LBS.	Du Pont R. R. P. LBS.	Blasting Powder. LBS.
3	4.25	3.75	3.68	3.60	3.72	3.25	3.00
3½	5.68	5.10	5.0	4.89	5.07	4.42	4.08
4	7.55	6.60	6.53	6.33	6.62	5.72	5.28
4½	9.35	8.40	8.38	8.06	8.38	7.28	6.72
5	11.80	10.50	10.2	10.08	10.35	9.10	8.40
5⅝	14.94	13.2	12.8	12.53	13.0	11.3	10.44
6	17.0	15.0	14.7	14.4	14.9	13.0	12.0
6½	19.5	17.5	17.25	16.8	17.49	15.2	14.0
7	23.1	20.4	20.0	19.6	20.28	17.7	16.3
8	30.2	26.7	26.13	25.6	26.49	23.1	21.4

Proper Spacing of Bore Holes

There is no hard-and-fast rule for the proper spacing of bore holes. All depends on the local conditions. With a 5⅝-inch bore hole, which is more commonly used, it is advisable at first not to exceed 20 ft. x 20 ft. in limestones. In harder rocks it is well to begin with closer spacing than this at first, say 15 ft. x 15 ft. It is a good plan to begin low and work up. Many times when poor results are attributed to the explosive or system of drilling it is found that the fault lies in poorly placed bore holes, making an unbalanced blast. This is a subject requiring study by the quarryman to suit each local condition. As a general rule, the bore holes should never be drilled more than 20 feet apart. The distance back may vary according to character of rock and method of loading. Bore holes should be drilled from three to five feet below the quarry floor unless there is a natural parting at that level in which case, if they are drilled to grade, bottom will come clean. Going below floor insures better breakage, cleaner floor and permits of easy access for a steam shovel if used.

No rule can be given as to the amount of explosives to use in bore holes of given depths. The important part is the selection of the proper explosive to produce the desired results. When the proper selection is made, knowing the spacing and the number of bore holes, by referring to tables on pages 12 and 15 the amount of explosives required and volume of rock to be removed can be easily ascertained.

As a general rule a bore hole of any depth should be filled at least half its length with explosive. A 40-foot bore hole should have 20 feet of explosive, a 60-foot bore hole 30 feet, and so on.

Location of Charge

In order to obtain maximum breakage and proper distribution of the explosive in the bore hole, the top of the charge should be at least 30 feet from the mouth of the bore hole, no matter what its depth. General practice shows it is best to load to within 20 feet of the surface in hard material. It is absolutely essential in order to obtain maximum results in blasting that the force be properly distributed.

In loading deep bore holes there is nothing gained by loading the explosive loose; that is, removing the paper shells. In fact, it is more dangerous to do so, as loose explosives may be scattered all along the walls of the bore hole and at the mouth. When this occurs, there is always danger of a stone working loose and becoming wedged between the tamping block and wall, causing friction and setting off the charge.

Various Sizes of Cartridges Now Available

Explosive manufacturers to-day put up explosives in cartridges of almost every size up to 5 inches in diameter. The quickest and safest way is best. Simply slit the cartridges longitudinally on two or three sides, dropping each cartridge separately until about 25 pounds have been loaded, and then tamp lightly with a wooden tamping stick. This may be increased to 50 pounds as you approach the top of the charge.

Bore Holes Should Be Tamped Thoroughly

The fall, especially when large cartridges are slit, will cause the explosive to practically fill the bore hole. Bore holes have been loaded where the powder was not tamped, blaster depending on the explosive to tamp itself by the fall. With some explosives very good results are obtained in this way, but it is well to tamp all, as the closer the confinement the better.

All the water possible should be removed from the bore holes before loading is started. If loading is done in cold weather, care should be taken to see that explosives are properly thawed.

Combination of Two Explosives Recommended

In hard rocks a combination of 60 per cent. and 40 per cent. dynamite is recommended. A little 60 per cent. should be loaded in the bottom of each bore hole and 40 per cent. on top. In soft, flat limestone a 40 per cent. explosive will usually be found strong enough, unless the spacing or the toe is heavy. If very wet and a heavy toe, a gelatin dynamite from 40 per cent. to 60 per cent. is recommended.

Position of Well-Drill Bore Holes

As a usual thing well-drill holes are driven and blasted in one line, the bore holes being equi-distant from the face. All the stone is then removed before the next blast is made. Occasionally, in very hard material better results are obtained by staggering the holes.

There is also another method of drilling and blasting known as shooting against the bank, or "buffer" shooting. By this is meant that a line of bore holes is shot down and then another line back of that is blasted before any of the debris from previous shot is removed. The first lift acts as a buffer to the second blast. This method is particularly well adapted to limestone formations in which the stone is flat and thinly laminated or disintegrated on top, and the face does not exceed 40 feet in height. It is only necessary to loosen the bottom in such a formation. "Buffer" shooting eliminates necessity of moving shovel as often as when clear bank method is used or lifting and laying tracks so frequently. Care must be taken not to load too high when this method is used, as often the break back makes it difficult to drill the next line of bore holes.

Strong Detonators Required for Best Results

Always use strong detonators, at least No. 6 Electric Blasting Caps and, better still, No. 8. In all holes at least two detonators should be used. A good rule to follow is to place a detonator every 25 feet in the explosive charge. If it is necessary to splice extra lengths to electric blasting cap wires, the joints should be carefully twisted, but not opposite or touching each other, and well taped. The use of sufficient primers serves the double purpose of assuring a thorough detonation of the explosive charge and also affords a way out in case one or more should be broken or otherwise damaged during tamping.

Dropping Cartridges in Bore Holes

In loading bore holes of extreme depth, the question might arise: "Is it safe to drop dynamite of, say, 60 per cent. or 40 per cent. strength such a distance?" Usually there is some water at the bottom of the bore hole, and the cartridges being slit, the dynamite does not receive a very hard shock when it reaches bottom. The water also serves as a cushion and, when above the water, the explosive already in the bore hole serves the same purpose. If, however, any hesitancy is felt about dropping dynamite in this way, the first few feet of bore hole can be loaded by attaching a sharp stick or spear to the end of a string, inserting the stick in a cartridge, and lowering almost to the bottom of the bore hole; then release the cartridge with a quick jerk of the string.

The Proper Kind of Tamping Block to Use

A tamping block should be of wood about 4 feet long, and just enough smaller in diameter than the bore hole to have good clearance. Do not use a block too small in diameter, as there is danger of loose stones falling in the bore hole and getting wedged between the block and the walls, causing trouble and anxiety. The tamping block, if necessary, can be weighted by boring a hole about 1½ inches in diameter at the bottom for about half its length and nearly filling same with molten lead or babbitt, and closing the hole with a wooden plug. By weighting the block in this way it is possible to tamp the explosive better at the bottom of the bore holes, where usually will be found some water. A rope should be fastened at the other end by boring a hole through the block from side to side and grooving above each end of the hole to the top of the block so that the rope will not project beyond the perimeter of the block.

For very deep bore holes a light tripod can be built and the tamping block operated by two men with the rope running through a pulley at the apex. This keeps the rope in the center of the bore hole and is easier for the men than lifting by hand. Another good arrangement is a heavy block shaped like a bootjack, with a pulley at the slotted end. This end is simply placed over the center of the bore hole and the rope is allowed to run over the pulley.

Tamping with the drill stem by screwing a wooden block on the end is extremely dangerous and should never be allowed.

The use of any metal parts in tamping is condemned by all authorities and a great many accidents have been caused in this way.

After each bore hole is loaded with the explosive charge it should be filled clear to the mouth with clay, sand or screenings, and tamped, care being taken to not break the insulation of the electric blasting cap wires or cordeau if used. Sand is the safest material to use for tamping large bore holes.

Approximate Amount of Stone per Pound of Explosives

Below is given briefly the record of some blasts made in different sections of the country. An average of four to six tons of stone per pound of explosive is about what should be expected in blasting deep bore holes.

A blast in a limestone quarry in Tennessee, stone used for ballast and commercial purposes, consisted of sixteen 5⅝-inch bore holes, average depth 75 feet. Holes were spaced 18 feet apart, with average face burden of 22 feet. 3,750 pounds of 60 per cent. and 3,700 pounds of 40 per cent. Low Freezing dynamite were used in the blast, producing 5.7 tons per pound of explosive.

A blast in cement rock in Pennsylvania consisted of fourteen 5⅝-inch bore holes, average depth 86 feet, spaced 18 feet apart, with a face burden of 30 feet. 4,850 pounds of 60 per cent. and 3,250 pounds of 40 per cent. were used, producing 55,000 tons, or 6.8 tons per pound of explosive.

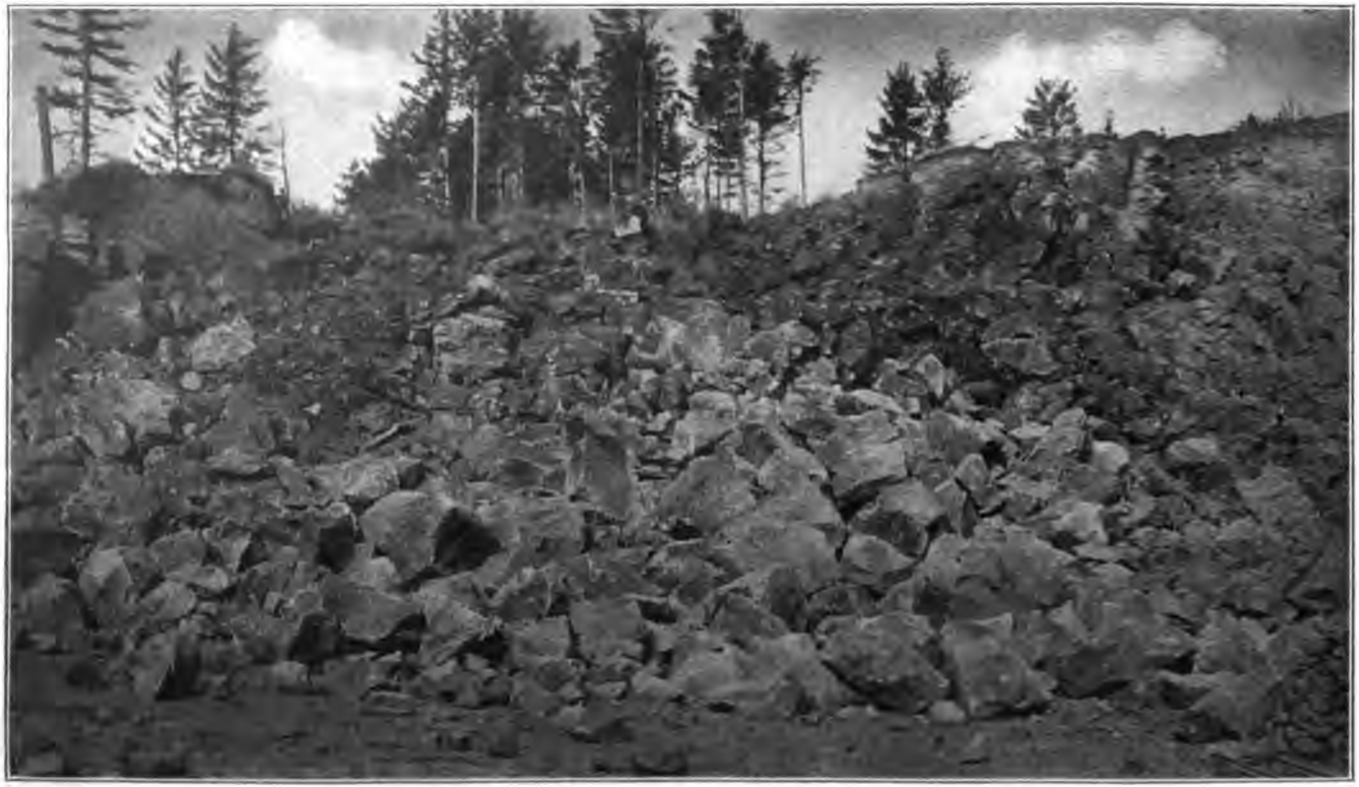
A blast in a Kentucky limestone quarry, stone used for ballast, consisted of nine bore holes, average depth 50 feet, spaced 18 feet apart and 25 feet back. 3,250 pounds of 40 per cent. dynamite were used, producing 16,200 tons, or 5 tons to the pound of explosive.

A blast made in an Oklahoma quarry, where stone was used for railroad ballast, consisted of 8 bore holes 95 feet deep, average space between holes 28 feet, with average face burden 33 feet. 2,200 pounds of Blasting Gelatin, 3,350 pounds of 60 per cent. and 1,250 pounds of 40 per cent. dynamite were used. A total of 6,800 pounds producing 62,000 tons, or 9 tons per pound of explosive. This blast was badly balanced, necessitating use of very strong explosive at bottom. The cost per ton was just as high or higher than a balanced blast.

A blast made in iron ore consisted of twenty-six 5⅝-inch bore holes of average depth of 84 feet. Spacing 15 x 15 feet. Holes were triple loaded and fired with cordeau and one electric blasting cap. 8,500 pounds of 40 per cent. dynamite were used, producing 50,000 tons of ore, or 5 tons per pound of explosive.

A blast made in cement rock in New Jersey consisted of 11 bore holes, average depth 102 feet. Spacing 20 x 22 feet. 2,040 pounds of 60 per cent. Gelatin and 4,475 pounds of 40 per cent. Gelatin were used, producing about 40,000 tons of stone, or 6 tons per pound of explosive.

A blast made in a West Virginia quarry, stone used for ballast,



RESULTS OBTAINED WITH DU PONT EXPLOSIVES IN AN OREGON QUARRY. BORE HOLES LOADED WITH 560 KEGS BLASTING POWDER, DETONATED WITH 40% N. G. DYNAMITE PRIMER CONTAINING No. 6 ELECTRIC BLASTING CAPS consisted of seven bore holes, average depth 60 feet. Spacing 18 x 20 feet. 1,600 pounds of 50 per cent. Gelatin and 1,200 pounds of 33 per cent. Extra Dynamite were used, producing 13,000 tons of stone, or 4.6 tons per pound of explosive.

The preceding data concerning blasts will serve to give a general idea of what should be expected in well-drill work.

Precautions to be Observed

The following rules should always be enforced:

Permit no smoking in the vicinity of the loading operations.

See that the men assisting in the work have no matches—especially friction matches—in their coat pockets. There is a chance of these falling into the bore hole while loading, and the result might be disastrous.

Do not allow loose powder to accumulate around the mouth of the bore hole. Cleanliness is important.

The nails in the sole of a man's shoe may cause sufficient friction to set the charge off. In a dynamite manufacturing plant no one wearing a shoe with nails in the sole is allowed in any of the buildings.

Do not bring all the explosive for the blast on the job at one time, and do not allow it to stand out in the open over night.

If possible, complete the loading and firing in one day. If it takes more than one day to load the bore holes, make no connections until just before firing. When left over night, bury the ends of the electric blasting cap wires with earth. An electric storm during the night has been known to set off a blast.

Do not prime or connect charges of explosives for electric firing during the approach or progress of a thunder storm. If already primed, keep everybody away until the storm is over.

Be sure dynamite is thawed before using. Do not cut or try to break a frozen dynamite cartridge, and do not load frozen dynamite in the bore hole.

DU PONT

BLASTING SUPPLIES

Contribute to

SAFETY, CERTAINTY and ECONOMY

In the Use of Explosives

THE very best grade of Blasting Supplies costs but a trifle in comparison with the charge of explosives. It is poor business economy to attempt to detonate explosives with inferior detonating materials.

By using Blasting Supplies sold by the Du Pont Company, you are sure of securing the best, which means relative safety to yourself and employees, certainty of detonation and most economic production in the quarry.

An experience of 113 years as powder makers has given us a practical knowledge of explosives. We make use of this in a manner which enables us to supply our customers with not only explosives of highest efficiency, but also with detonating materials especially adapted to our products.

Every article described can be depended upon to be as represented. "As good as Du Pont" is the best reason for insisting upon securing Du Pont Blasting Supplies.

Box Du Pont No. 6 Blasting Caps

Blasting Caps

We make two different strengths, put up in tin boxes of different colors, as follows:

	Du Pont No. 6	Du Pont No. 8
Color of box............	Red	Green
Length of shell..........	1½ in.	2⅛ in.
Weight of charge in grains,	15.4	30.8

Each tin box contains 100 blasting caps, and these tin boxes are packed in pasteboard cartons of 1,000 each and in wooden cases as follows:

Du Pont No. 6 Blasting Cap

Case No. 0 containing 500 blasting caps.
Case No. 1 containing 1,000 blasting caps.
Case No. 2 containing 2,000 blasting caps.
Case No. 3 containing 3,000 blasting caps.
Case No. 5 containing 5,000 blasting caps.

Fuse

The kinds of Fuse adapted to the following classes of work are generally used.

Sold east of Montana, Wyoming, Colorado and New Mexico:

Dry Work	**Damp Work**
Hemp (White),	Beaver,
Superior Mining,	Charter Oak.
Planet.	
Wet Work	**Very Wet Work**
	Crescent,
	Clover.

Coil of Fuse

Sold west of and including Montana, Wyoming, Colorado and New Mexico:

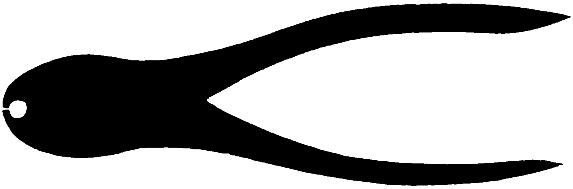
Dry Work	**Damp Work**	**Wet Work**	**Very Wet Work**
Hemp (Black),	Comet,	Victor,	Pacific,
Blue Label.	Sylvanite.	Bear.	Monarch.

All Fuse is packed in cases of 500 to 6,000 feet.

Cap Crimpers

The Du Pont Cap Crimper is made with a crimper which makes a cylindrical crimp of the blasting cap to the fuse.

It also has one rounded handle to use in making the hole in the primer cartridge for the blasting cap or electric blasting cap.


Du Pont Cap Crimper

Blasting Cap Crimped on Fuse With a Du Pont Cap Crimper

ELECTRICAL APPARATUS FOR DETONATING EXPLOSIVES

Electric blasting is the safest, quickest, best and most effective method of detonating explosives.

When several charges are fired simultaneously, each aids the other and consequently more material is blasted out. For this purpose the Du Pont Company manufactures three kinds: the ordinary type for dry or damp work; the waterproof type for work where considerable water is encountered; and the submarine type where they will be used in water over 30 feet deep.

Occasionally it is desired to detonate each charge of explosives separately or in rotation by one application of the electrical current. For the purpose we recommend the Du Pont Delay Electric Igniters and the Du Pont Delay Electric Blasting Caps.

For igniting blasting powder we recommend the Du Pont Electric Squib, which can be used with or without a blasting cap.

Any and all of the above detonators can be used in the same electric circuit. When using a blasting machine they should always be connected in **series,** but when an electric power circuit is used, it is best to connect them in **parallel** or **parallel series.** In the latter case it is necessary to have one and one-half amperes per series.

It is possible to better protect electrical blasting apparatus against water and other causes of misfire. "Hang fires" are hardly possible if blasting by electricity. The possibility of accidents due to delayed action is, therefore, reduced to a minimum. The charges can be detonated when desired and when everyone is in a safe place.

The adoption of Du Pont Explosives and Electrical Detonators will insure a maximum output at a minimum of cost and liability to owners of quarries.

Du Pont Electric Blasting Caps

These are made in two different strengths—No. 6 and No. 8, having insulated copper or iron wires. The copper wire Electric Blasting Caps are of the following lengths:

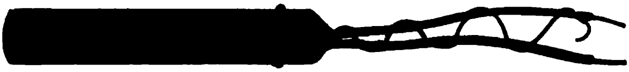
4 ft. 6 ft. 8 ft. 10 ft. 12 ft. 16 ft. 20 ft.

The iron wire Electric Blasting Caps are of the following lengths:

2 ft. 4 ft. 6 ft. 8 ft.

The copper wire Electric Blasting Caps are also made of the Waterproof and Submarine types in the same strengths and are strongly recommended for wet work and submarine work respectively.

Electric Blasting Caps are packed in cartons containing 25 or 50, depending on the length wire. Each wooden case contains ten cartons.



Du Pont No. 6 Electric Blasting Cap

Du Pont Delay Electric Blasting Caps

These are made in No. 6 strength only and in two delays—First Delay and Second Delay. When used with the instantaneous electric blasting caps in the cut holes, gives three delays. They have the same length insulated copper wires and are packed the same as the Du Pont Electric Blasting Caps.

Du Pont Delay Electric Blasting Cap

Du Pont Delay Electric Igniters

These consist of a brass tube, into one open end of which is fastened the insulated copper or iron wires, and in the other end is crimped different lengths of fuse according to the delay period. The First Delay has 2 inches of fuse, the Second Delay has 4 inches of fuse, and so on, increasing the length of fuse by 2 inches for each longer delay. The fuse is ignited by electricity. When used to ignite blasting powder, it is not necessary to use a blasting cap. When used to detonate dynamite, it is necessary to crimp either a No. 6 or No. 8 blasting cap to the fuse. In wet work, if the entire igniter, after the blasting cap is crimped to the fuse, is dipped in P. & B. paint, heavy axle grease or Kapseal, they can be used successfully. They have the same length wires and are packed the same as the Du Pont Electric Blasting Caps.

Du Pont Delay Electric Igniters

Du Pont Electric Squibs

These are used for igniting blasting powder. They are made with insulated copper or iron wires in lengths the same as Du Pont Electric Blasting Caps and are packed the same.

Du Pont Electric Squib

Connecting Wire

This is used to join the wires of electric blasting caps together, when they are not long enough to reach adjoining holes. It is put up on 1- and 2-pound spools. We recommend No. 20 (B. & S.) gauge. A 1-pound spool contains about 210 feet of insulated wire.

Spool of Connecting Wire

Leading Wire

Coil of Leading Wire

For connecting the circuit of electric blasting caps to the blasting machine, insulated copper wire is necessary. We supply No. 14 (B. & S.) gauge, single or duplex leading wire, put up in coils from 200 to 500 feet in length.

Du Pont Blasting Machines

These are made in five different sizes. The Du Pont Pocket, which has a detachable handle, will fire four electric blasting caps; the No. 2 will fire ten; the No. 3 will fire thirty; the No. 5 will fire one hundred; and the No. 6 will fire one hundred and fifty. All are made of the "Push Down" type except the Du Pont Pocket, which is a "Twist Type."

Du Pont Pocket Blasting Machine

No. 5 Du Pont Blasting Machine

All Blasting Machines are thoroughly tested before shipping. Every part is standardized and broken parts can be promptly replaced.

Du Pont Galvanometers

Du Pont Galvanometer

This instrument still continues to be one of the most necessary accessories for blasting, as by their use it is possible to determine positively whether the electric circuit is complete or broken, or whether it is short-circuited.

It is also possible to determine the presence of any broken wires in the electric blasting caps, even after they have been loaded in the bore holes. It is a positive necessity on work where much time is ordinarily lost looking for causes of misfire.

Du Pont Rheostats

This is an instrument used for testing Blasting Machines. By its use in connection with an electric blasting cap, it is possible to determine not only whether a blasting machine is up to its full strength, but also how many electric blasting caps it can be depended upon to fire.

For more detailed information regarding the Du Pont Galvanometer and the Du Pont Rheostat, see our pamphlet "Testing Circuits and Blasting Machines," a copy of which will be sent free on request.

Du Pont Rheostat

Cordeau-Bickford Fuse

This is an instantaneous safety detonating fuse which increases the efficiency of an explosive charge. It is not dangerous to handle or store; is not sensitive to friction or fire, and cannot be detonated by an ordinary shock. It eliminates the blasting cap in the hole, and also the possibility of a portion of an unexploded charge accompanied by a cap remaining in the broken rock. It is in lengths nearest to customer's requirements, avoiding unnecessary waste.

Cordeau is especially valuable for use where large charges of explosives are loaded at one point, such as deep "well-drill" holes and in quarry tunnel blasting.

THE
NATIONAL FARM HAND

DU PONT

EXPLOSIVES

Extensively and Successfully Employed in Every Section of the Country for the Blasting of Stumps and Boulders, Making Tree Holes, Shattering Hardpan, Digging Ditches, Etc.

THE use of over 17 million pounds of **Du Pont Explosives** in one year by farm owners indicates how popular this "national farm hand" is. The efficiency of the special grades of **Du Pont Explosives** especially made for farm uses, coupled with their moderate cost accounts for the countrywide adoption of the "farming with dynamite" idea.

The variety of uses for **Du Pont Explosives** and the practical methods gained by actual field experiences are clearly explained and illustrated in our newest edition of our "**Handbook of Explosives**" promptly mailed to anyone interested.

E. I. du Pont de Nemours & Company
Powder Makers Since 1802
WILMINGTON, DELAWARE

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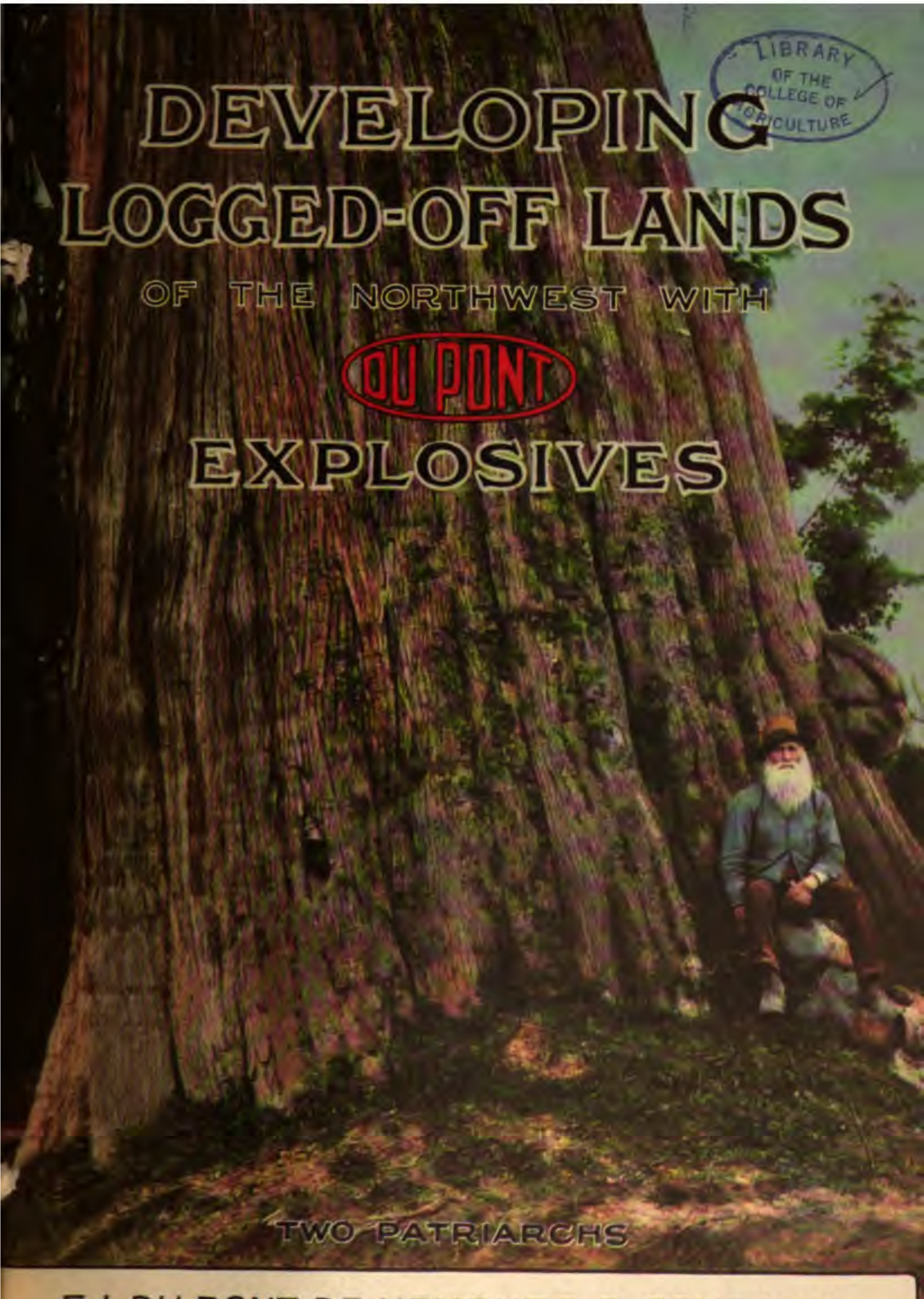
DEVELOPING LOGGED-OFF LANDS

OF THE NORTHWEST WITH DU PONT EXPLOSIVES



TWO PATRIARCHS

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PIONEER POWDER MAKERS OF AMERICA

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JUNEAU, ALASKA

INSTRUCTIONS

IN THE USE OF

DU PONT *and* REPAUNO STUMPING POWDER

FOR

CLEARING LAND, PLANTING AND CULTIVATING TREES, DRAINAGE, DITCHING AND SUBSOILING

REPAUNO STUMPING POWDER AND DU PONT STUMPING POWDER ARE DESIGNED PARTICULARLY TO MEET PACIFIC COAST CONDITIONS AND CAN BE PURCHASED IN NEARLY ALL LOCALITIES WEST OF THE ROCKY MOUNTAINS

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E. I. du Pont de Nemours & Company
Established 1802
Wilmington, Delaware

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TYPICAL TRACT OF LOGGED-OFF LAND IN THE NORTHWEST

"THE most serious agricultural problem of the Northwest to-day is the development of the logged-off lands of Idaho, Oregon and Washington. In Oregon and Washington alone more than 3,000,000 acres of such logged-off lands are lying idle, although much of this area has fine agricultural soil and a climate that insures abundant crops and the development of thriving communities."

—*Extract from Department of Agriculture Year Book, 1915.*

Land Clearing

When the development of the fertile, cut-over lands of the Pacific Northwest was made possible by the improved transportation facilities afforded by better roads and more railroads, attention was first given to ridding the lands of stumps.

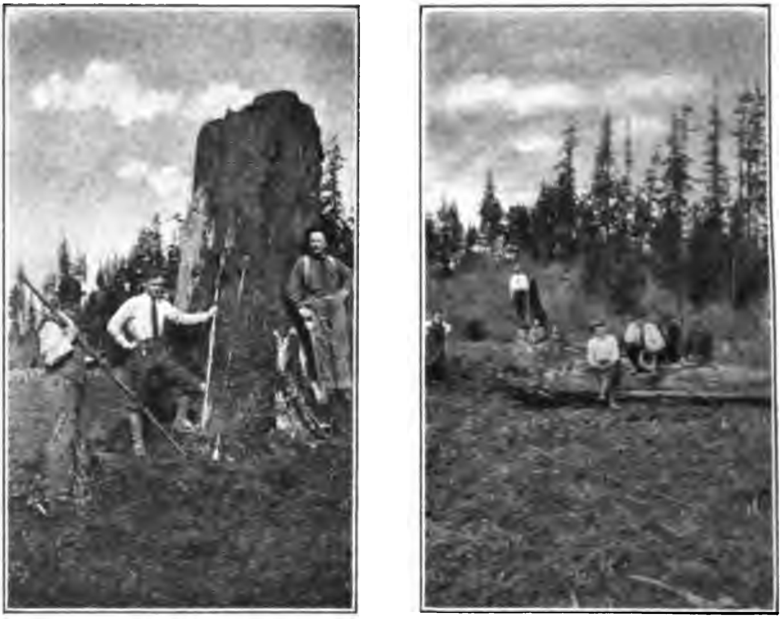
The favorable soil and climatic conditions had developed wonderfully large trees that stood thick on the ground. A cut of 55,000 feet B. M. of lumber per acre was about the average. This heavy growth naturally left a big problem in the removal of stumps, so that a quick, economical, and effective means to rid the cut-over land of stumps was required.

THE FERTILE SOILS AND ABUNDANT RAINFALL RESULTED IN A THICK GROWTH OF TIMBER

Black powder was used in the first attempts at blasting stumps, but this was not entirely satisfactory, as the bulk of the charge was too great to be easily loaded, and its action was too slow to obtain the desired results.

The earlier forms of dynamite and low powder were then used with better results. Various tests showed that there was still room for improvement, and the Du Pont Company spent much time and effort in developing explosives that would do the desired work; that would be easy to handle; and that would withstand the climatic and other adverse conditions. These investigations and trials resulted in the development of Du Pont Stumping Powder and Repauno Stumping Powder, both cold resisting.

The development of these two explosives required much time but the results fully warranted the effort.



BEFORE AFTER

THE EFFECTS OF A WELL-LOCATED CHARGE OF DU PONT EXPLOSIVES

BEAUTIFUL AND PROFITABLE OREGON PRUNE ORCHARD MADE POSSIBLE ON WELL CLEARED LAND

LOADED TOO HEAVY. WHEN A STUMP IS PROPERLY LOADED, THE FRAGMENTS ARE BLOWN OUT, BUT WHEN LARGE FRAGMENTS ARE THROWN GREAT DISTANCES, IT IS A SURE PROOF THAT TOO MUCH POWDER IS BEING USED OR THAT THE CHARGE IS NOT PROPERLY LOCATED

Low Freezing Stumping Explosives

The chief objections to the older types of dynamite were that they would freeze with slight exposure to cold, they were sensitive and dangerous to handle, and deteriorated under adverse climatic conditions.

In Du Pont Stumping Powder and Repauno Stumping Powder these difficulties have been overcome, so that they are not so quickly affected by cold. They freeze and thaw at about the same temperature as water, and when properly stored can be used without the necessity of thawing in colder weather.

Their composition is such that they are less sensitive to the shocks incident to hauling and handling. In fact, they have been so far improved in this respect that stronger caps are required to fire them to get the full result of these explosives.

They withstand the adverse climatic conditions, and can be used under practically all conditions encountered in the development work.

Use of Explosives in Land Clearing

Explosives are used in land clearing to get rid of stumps, standing trees, heavy logs, and boulders, because they reduce the cost of the work, hasten its completion, and leave the fields deep tilled, ready for cultivation.

The degree of efficiency with which they can be used is very high, and with experience, the blaster can work them to accomplish wonders.

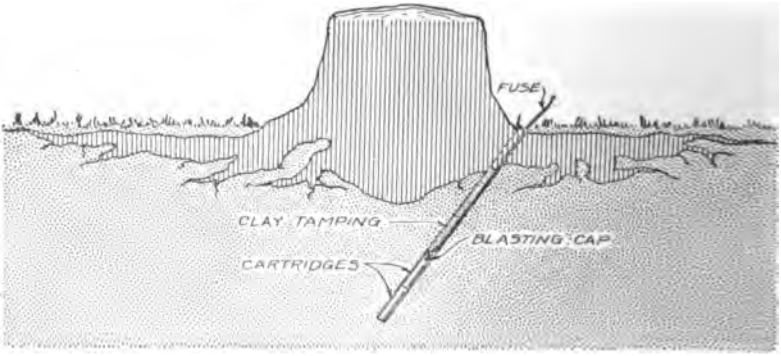
GENERAL VIEW OF BLASTED STUMP FRAGMENTS ON LIGHT CLEARING

Cost of Land Clearing

The cost of land clearing in this region of large stumps is a matter of study on each individual piece of land. " How much will it cost to clear an acre? " is as hard to answer as, " How much lumber will it take to build a house? " The cost will vary with the size and number of the stumps, with the degree of decay, and with the nature of the soil.

Blasting Stumps

In blasting out stumps the charge of explosives should be placed and regulated so as to lift out the stump with as many roots as possible. This requires some experience and a close study of the individual stump to be blasted.



CORRECT METHOD OF LOADING A SMALL STUMP. THE CHARGE SHOULD BE PLACED UNDER THE PART OF THE STUMP THAT IS HARDEST TO LIFT AND WELL BELOW GROUND

Small Stumps

The usual method of blasting small stumps is as follows:

Begin a hole, with an auger or punch-bar, a little way back from the stump and slope it downward under the stump as is indicated in the accompanying sketch. The charge of stumping powder should be pressed tightly in the bottom of the hole, with a cap and fuse primer on the top. The hole should be well tamped.

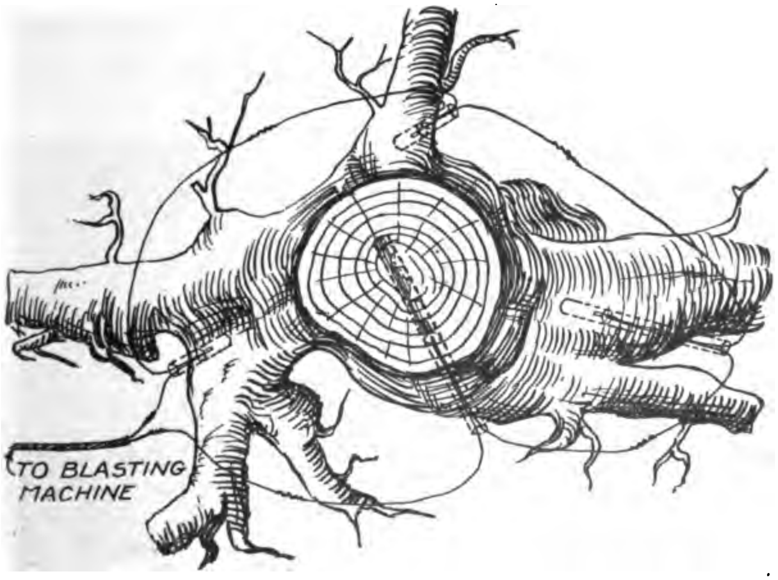
The amount of Du Pont Stumping Powder or of Repauno Stumping Powder required will depend on the soil, and on the size and condition of the stump. The amount will vary all the way from less than a cartridge for the very small grubs up to several pounds for the larger stumps and can be determined only by trials. Begin on the small stumps and after satisfying yourself as to the correct charges to use, try the big ones.

The main part of the charge should be well below the heaviest part of the stump to lift.

See page 91 for method of making a primer with cap and fuse; and pages 94 and 95 for the method of loading and tamping.

Stump Blasting With Electricity

This requires the use of two or more holes placed under and around the stump and large roots, as is indicated by the accompanying diagram. The same explosive is used, but Electric Blasting Caps must be used instead of the cap and fuse. One of these is used in each hole. See page 91 for methods of making a primer with Electric Blasting Cap,



CORRECT METHOD OF LOADING A STUMP FOR AN ELECTRIC BLAST. ONE CHARGE IS PLACED IMMEDIATELY UNDER THE STUMP; OTHER CHARGES ARE PLACED UNDER THE LARGE LATERAL ROOTS. ELECTRIC BLASTING CAPS ARE REQUIRED

STUMPS 4 FEET AND 6 FEET IN DIAMETER. THEY CAN BE READILY LIFTED BY ELECTRIC BLASTS

and page 95 for methods of loading and tamping. When the holes are all loaded, connect the wires to the leading wire in series as is indicated in the sketch, using the precautions pointed out for electric blasting, beginning on page 98.

This method is recommended for hollow stumps where a single large charge cannot be depended on to do the work.

THE VACANT THRONE OF A DEPOSED MONARCH OF THE HUMTULIPS VALLEY

VIEW OF LOGGED-OFF LANDS WAITING FOR THE STUMP BLASTER

Blasting Stumps of Diameter of Eight Feet and Upward

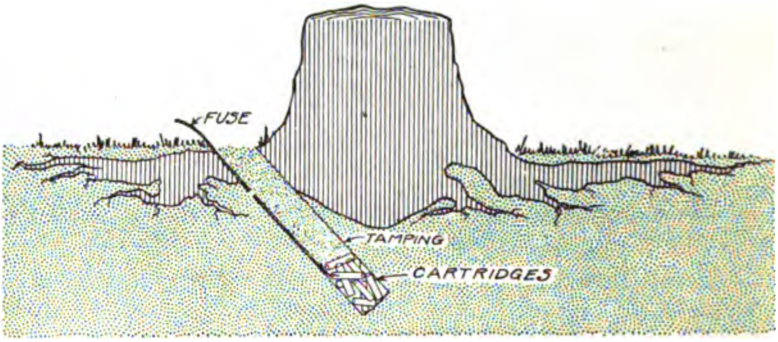
Neither of the foregoing methods will prove satisfactory in blasting the large fir and spruce stumps of the Northwest. The best practice is to bore three or more holes with an auger of 2-inch diameter or larger, to a depth of 6 to 8 feet, at an angle of 45 degrees, under the stump. As each hole is bored spring it with one-half cartridge of stumping powder, then load with the charge for that hole, priming same with an Electric Blasting Cap. When the desired number of holes are prepared, connect the several small wires with the leading wire, and fire electrically. See page 98 for methods of connecting up for an

READY TO LOAD

electrically fired blast. In the case of old, partially burned or decayed stumps and cedar stumps the practice is to place the blasts under the strongest holding roots, and fire electrically as described.

Blasting Medium Sized Stumps Four to Eight Feet in Diameter

The most satisfactory method is to dig a hole directly under and a little past the center of stump, gaining a depth of 12" to 20" below base of stump. In dry ground slit the cartridges and press the charge into one mass. Fire with fuse and cap, placing the primer cartridge on top of the charge. The quantity of explosives to be regulated for effect of blast whether it is desired to blow stump entirely out, or to crack same for pulling with donkey engine, or burning. The method of loading is clearly shown in the accompanying sketch.



LOCATION OF HOLE AND METHOD OF LOADING DESCRIBED IN THIS PARAGRAPH. THE SHOVEL FOR MAKING THE HOLE IS SHOWN ON PAGE 89.

General Instructions

The explosives recommended are Du Pont Stumping Powder and Repauno Stumping Powder. The charge must be packed firmly into the bottom of the hole. The *primer* must be in *close contact* with the *rest of the charge.* See page 91 for methods of making a primer. The hole is then ready to tamp. The tamping should be firm and solid.

The rules to be followed in blasting big stumps can be summarized briefly as follows:

1. Measure diameter of the stump.
2. In clay or hardpan use two to four pounds of stumping powder to the foot diameter.
3. In gravelly soils use three to four pounds to the foot diameter.
4. In loam and sandy soils use three to five pounds of stumping powder to the foot diameter.
5. When the stumps are on a hillside dig the hole from the upper side.

6. Where stumps are solid, get the powder well below the base of the stump and a little past the center.

7. If the stumps are burned or decayed, sink the holes to a depth of two feet below the base so as to give the explosive room to "spread" and lift against as large an area of the base as possible. Such stumps are most successfully removed by electrically fired blasts, as is shown on page 9.

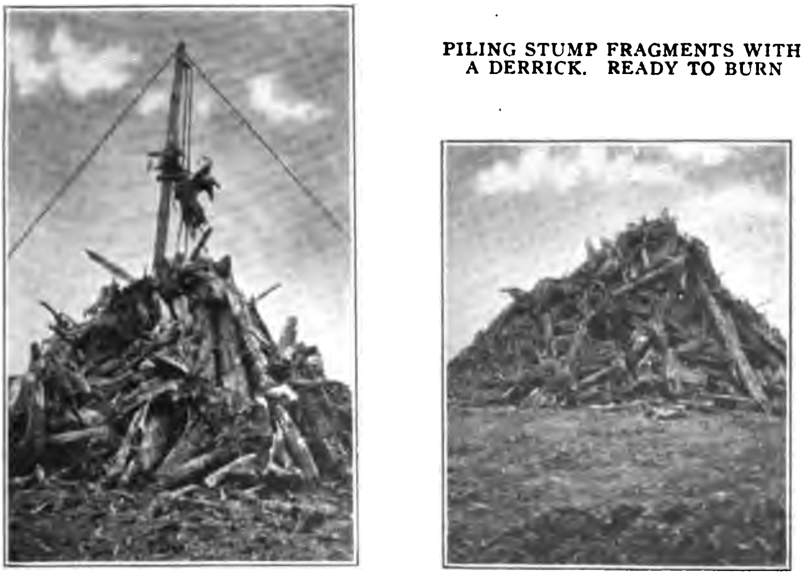
8. In blasting big stumps, the hole should be dug large enough to permit placing the entire charge of explosives under the center of the stump, but the hole should be only large enough to accommodate the charge, as larger holes are difficult to tamp and do not permit a proper confinement of the explosive.

9. The charge should be firmly tamped. Avoid being on the same side of the stump as the hole when the blast is fired, as fragments are thrown with more violence and to greater distances on that side.

The foregoing instructions are intended to cover common or general conditions, the experience of the blaster must always be his guide when unusual conditions are to be dealt with.

Piling and Burning

When the stumps are all blasted they can be quickly and easily drawn together and piled for burning by any one of several methods. They can be dragged into low, flat piles by means of teams or a small tractor; the fragments of each stump can be piled separately by hand; or large piles can be made by means of a donkey engine, portable derrick, or other mechanical device of this general nature. The last named methods are to be preferred especially when there is a large amount of work to



PILING STUMP FRAGMENTS WITH A DERRICK. READY TO BURN be done, or where the stumps are to be left for some time before burning. When this is the case, the piles should be made as large as is convenient.

Combination Methods

The methods that have just been described are for blasting out stumps without other aid. Under some conditions it is found better to adopt a combination method where explosives are used in connection with donkey engines, or capstan pullers.

FRAGMENTS OF STUMP THAT HAS PREVIOUSLY BEEN BLASTED BEING PULLED BY DONKEY ENGINE

When a combination method is employed, the amount of explosive used and the method of loading are different. The blasting is then done to split the stump into fragments and loosen the soil from the roots, so that the individual fragments may be easily pulled and piled without trouble from the heavy masses of soil that prevent successful handling of the stumps pulled without blasting. These combination methods often result in a material saving in the total cost of the job, especially where large areas are to be cleared.

For such work the loading should be just heavy enough to thoroughly split the stump and shake the roots loose from the confining earth. It should be lighter than is used for blasting the stump out entirely.

The loading is indicated in the diagram on page 15. Either Du Pont or Repauno Stumping Powder will be found to be entirely satisfactory for this work. The bore hole for loading the splitting charge can be made with either an auger or a drill, and it is seldom necessary to spring the hole.

Blasting Down Trees

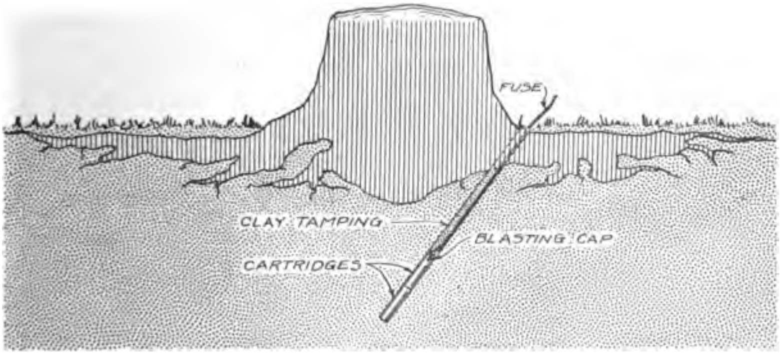
When it is desirable to blast down trees, the methods of loading employed are exactly the same as for blasting the stump of similar size and kind, with the exception that heavier loading is required.

DONKEY ENGINE PULLING AND PILING BLASTED STUMP FRAGMENTS

The Subsoiling Effects of Stump Blasting

A later chapter will point out the many advantages of blasting tight subsoils for crop production. This same shattering of the hardpan and deep subsoil is produced by stump blasting, as the heavy charges used will completely pulverize the adjoining soil and render it open for the absorption of moisture and for a suitable home for the roots of the crop that is to be grown.

The blasts also assist in perfecting good drainage by breaking up the confining strata of soil that have held the water on the surface.



FOR SPLITTING THE STUMPS BEFORE PULLING, A LIGHTER CHARGE IS USED. THE METHOD OF LOADING IS ABOUT THE SAME AS FOR BLASTING OUT STUMPS

The following pages give the experiences of some of those who have used explosives for land clearing.

Five Thousand Acres Cleared With Du Pont

We have used Du Pont Stumping Powder successfully in our land clearing department during the past two years. We have cleared during that period of time approximately 5,000 acres of land. The land was originally covered with pine, fir and tamarack, ranging in size from three feet in diameter down.

The powder serves the double purpose of splitting the stump and jarring the soil loose from the roots. We previously tried donkey engines without the use of dynamite; experience showed that a very large amount of soil adhered to the roots, leaving the ground uneven and requiring further work in cleaning the roots before the stump could be burned.

PILING THE BLASTED STUMP FRAGMENTS WITH HORSE-POWER DERRICK

We have used both the Du Pont Stumping Powder and Red Cross Extra 40 per cent. Dynamite. Both have their advantages and which is the most economical depends upon local conditions.

ARCADIA ORCHARDS COMPANY,
Deer Park, Wash.

Uses Explosives for a Variety of Purposes

Having read of the great number of uses to which you were putting your explosives I tried out several classes of the work to my entire satisfaction. I had three acres of greasewood which I wished to clear and with about 125 pounds of your 20 per cent. powder cleared this land of the heavy growth at a much cheaper figure than it could possibly have been done by any other means. Furthermore the crop of clover to which this ground was sown is of A-1 quality and size and the usual lack of growth on land where greasewood has grown was not evident in any part of the field.

This spring I set out about 900 apple and pear trees in holes which I shot with but one-eighth pound of 30 per cent. and at this time the result has been but a 4½ per cent. mortality as compared with a 10 to 20 per cent. loss in some other tracts where I used spaded holes. The growth in this first year is twice as great as in the orchards planted in spaded holes.

Then I subsoiled three acres of apple trees planted in spaded holes two years ago which were failing to make proper headway and the result has been that all of these trees made from four to six feet of growth this season. The trees are 22 feet apart and I broke the hardpan at an average depth of four feet in the tree rows. I used ⅜ pound of 20 per cent. powder for these shots.

I also removed quite a number of sunken boulders on my place, using 60 per cent. Red Cross Extra, and this work was also entirely satisfactory.

You can judge from the above that my experiments have proved that your contentions were apparently based on logical reasoning and your own experiments and I can unhesitatingly recommend the use of your products for the uses for which you claim advantages in orchard and farm work. I will do a large amount of shooting this season.

JAMES W. MATSON,
No. Yakima, Wash.

Vermin Leaves Cleared Land

I cleared three acres of stump land with Red Cross—had tried to farm around the stumps for three years, but could never get a good stand of corn because of moles that made their headquarters near the stumps. I never saw a mole after I removed the stumps and have been getting a fine stand of corn and good crops ever since.

DANIEL STAKER.

Couldn't Get Along Without Du Pont Stumping Powder

During the past two years I have blasted about 50 fir, cedar and Madrona stumps of all sizes. I would not think of undertaking it by any other method than with Du Pont Stumping Powder. I shall use the Stumping Powder whenever I do this work and I have done all of it, so far, by myself.

E. M. RICE,
Longbranch, Wash.

FRAGMENTS OF LARGE STUMPS AFTER BLASTING

Land Quadrupled in Value by Clearing

Blasted stumps ranging in size from six inches to five feet with Du Pont Stumping Powder. Value of land increased from $50 and $75 per acre to $200 or more per acre. Du Pont Stumping Powder is the best method by far for removing stumps.

J. FINLEY HEACOCK,
Stanwood, Wash.

Du Pont Stumping Powder Useful in Farm Work

Blasted 35 stumps with Du Pont Stumping Powder at one-half the cost of any other method. Have more stumps to remove and will use Du Pont Stumping Powder.

Planted some peach trees with Du Pont Stumping Powder and think it is great.

DR. C. G. BROWN,
Spokane, Wash.

Dynamite a Necessity for Land Clearing

We have obtained excellent results with your explosives in the clearing of our cut-over lands. We believe that dynamite is a necessity in the successful clearing of stump lands, and the day is not very far distant when the farmer will depend as much upon dynamite for clearing and cultivating his land as the contractor does for removing rock in railroad construction.

THE MICHIGAN LAND & LUMBER CO.
Clarence F. Carey, Sec.-Treas.
Careywood, Idaho.

MULTIPLE HITCH OF CABLES FOR PULLING AND PILING SEVERAL FRAGMENTS OF A BLASTED STUMP AT ONE OPERATION

Clearing Land of Boulders and Ledges

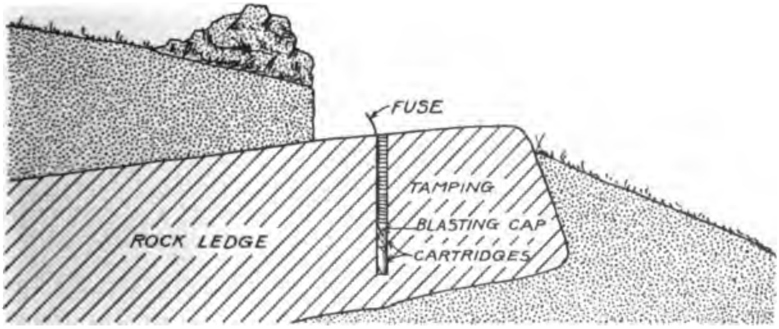
Many parts of the Pacific Northwest are badly troubled by field boulders and outcropping ledges of rock. These create a demand for explosives for clearing, because there is no method other than blasting by which they can be removed.

As in stump blasting, the early work of this sort was done with Black Blasting Powder, but more recently either dynamite or stumping powder is used, as these do the work cheaper and better.

FRAGMENTS OF A LARGE BOULDER AFTER BLASTING

Boulder Blasting

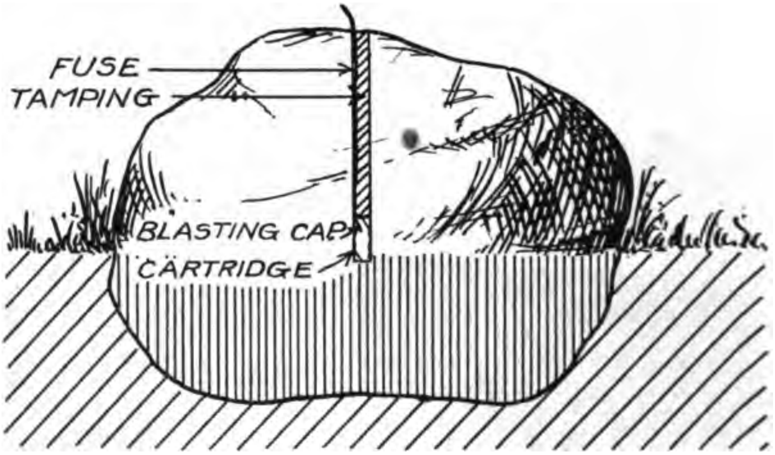
There are three distinct methods of loading for breaking loose field boulders. These are: "Blockholing," "Snakeholing" and "Mudcapping." Blockholing requires the smallest amount of explosives, but the most labor; while mudcapping requires the smallest amount of labor, but a considerably larger amount of explosives; snakeholing is intermediate in both labor and amount of explosives required.



CORRECT METHOD OF LOADING THE OUT-CROP OF A ROCK LEDGE

Blockholing

Blockholing consists of drilling a hole into the boulder and charging it with a small amount of dynamite. It is the best method for breaking very hard or very large boulders, especially those of the " nigger-head " type that are so difficult to break by other methods. The hole should usually be drilled about half way through the boulder and may be an inch or larger in diameter.



PROPERLY PLACED BLOCKHOLE CHARGE

The explosive should be removed from the shell and packed firmly into the bottom of the hole. When the entire charge is in, make a hole for the cap in the top of the powder with a pointed hardwood stick. Press the cap into the hole and tamp it in with moist soil. The hole should be tamped full.

As the confinement is perfect in such loading any of the Du Pont high explosives recommended in this book will give good results. Du Pont or Repauno Stumping Powder is especially recommended.

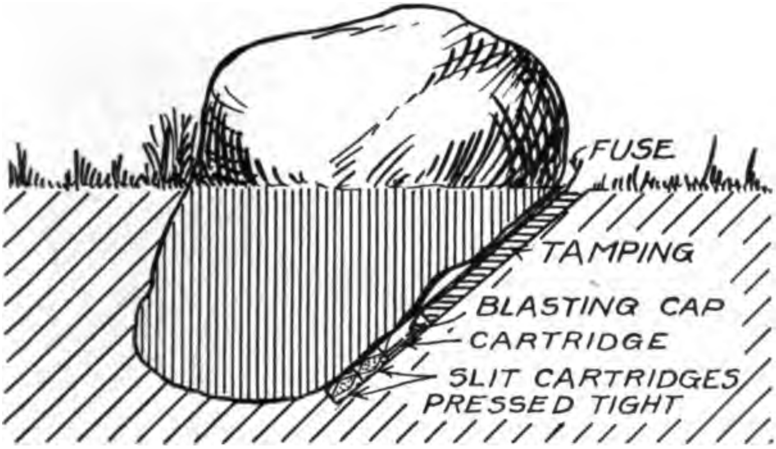
Blockholing is very effective in blasting off out-cropping ledges that are too large to remove entirely.

Snakeholing

Snakeholing consists of punching a hole under, but immediately against the bottom of a boulder and placing the charge of explosives in as compact a shape as the size of the hole will permit. A better idea of the method can be had by glancing at the figure. The explosive being confined on the underside by the earth, can exert a powerful blow on the boulder and will roll it out, or if a sufficient charge is used will break it in fragments.

This is one of the easiest and most successful methods of boulder blasting. The best explosives for this work are either Du Pont or Repauno Stumping Powder or Red Cross Extra 40 per cent. Dynamite.

Electric blasting is not generally used unless the boulders are very large and more than one charge is used to blow them out. Many blasters prefer to lift boulders out with a snakehole shot and later break them with a mudcap.



PROPER METHOD OF PLACING AND LOADING A BOULDER FOR SNAKEHOLE SHOT

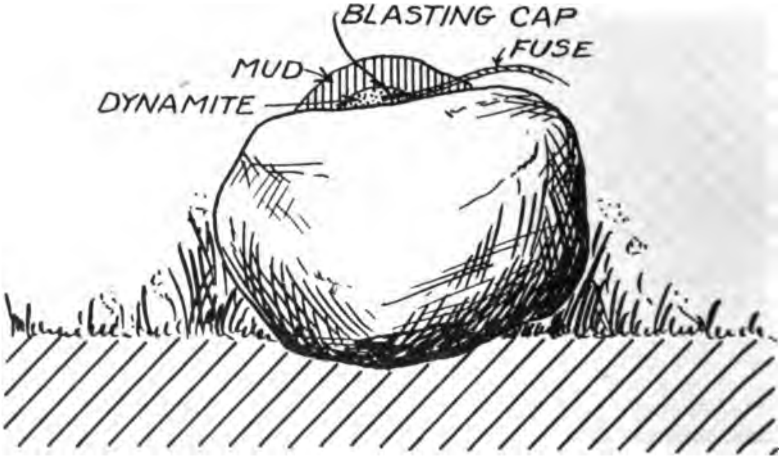
Mudcapping

Mudcapping is known by a variety of fantastic and expressive names, such as "Bulldozing," "Blistering," "Poulticing" and "Adobe Shooting," and is made possible by the fast, shattering action of the higher grades of dynamite. In practice it consists of removing the dynamite from the shell and packing it in a compact conical heap on the boulder, and after inserting a cap and fuse covering it with several inches of thick, heavy mud.

HEALTHY YOUNG APRICOTS ON LAND FROM WHICH THE BOULDERS HAVE BEEN BLASTED. NOTE BOULDER FRAGMENTS IN FOREGROUND

The explosive should be placed on the boulder at the place where it would be struck with a hammer were it small enough to break in that way. This may be on the top or side. If the boulder is embedded in the ground, a snakehole shot to roll it out on the surface should first be made, because the confining dirt makes it much harder to break with a mudcap shot. The mud covering should be as thick and heavy as it is convenient to make it, not less than 5 or 6 inches, and should be free from stones, as the blast will throw them as though they were bullets. Never lay a stone on top of the mud for the same reason.

The explosives used are Red Cross Extra 40 per cent. for easily broken rock, and Du Pont Straight 50 per cent. for hard nigger-head boulders.



CORRECTLY PLACED MUDCAP. THE MUD COVERING SHOULD BE SEVERAL INCHES THICK

Combining Mudcapping With Snakeholing for Large Boulders

For very large loose boulders, where it is not practical to drill, it is often well to combine these two methods of loading, using one or more charges in snakeholes and a big mudcap. The explosions on two sides at the same time intensify the shock to the boulder to such a point that it will break when either method of loading alone would be ineffectual. Such charges must be fired electrically.

Disposal of Boulder Fragments

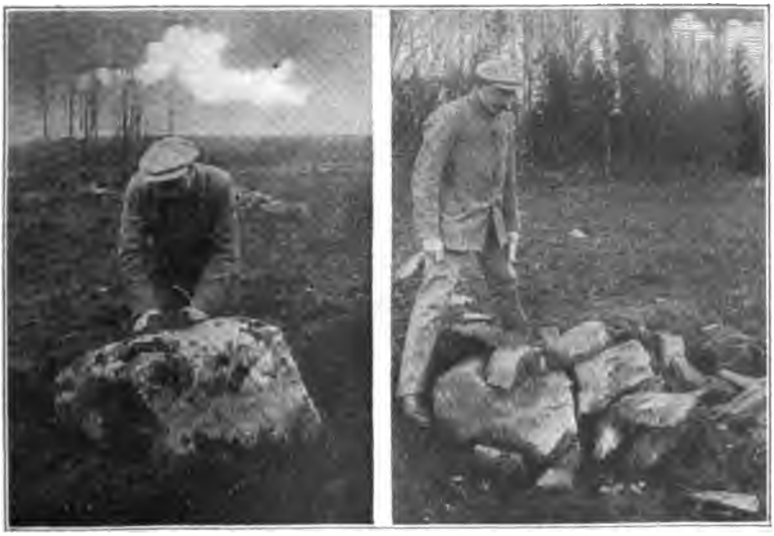
Many uses can be made of boulder fragments after the blasting is done. The accompanying cut shows a beautiful home built of fragments of field stones by a progressive blaster who was clearing up a large field. Other uses are for building foundations, walls, fences, roads, for making concrete, or for various other uses about the farm.

They are also very useful for filling gullies or discarded ditches, and, as they do not lie close together, will form blind drains to remove excesses of rain water.

Where large boulders leave deep holes much of the debris can be buried in the bottom of the holes, but care must be taken to keep it well below plow depth.

The possible use of boulder fragments for road improvement should always be kept in mind.

HOUSE BUILT OF FRAGMENTS OF BOULDERS BLASTED FROM ADJOINING FIELD



SUCCESSFUL BOULDER BLASTING IN SWEDEN, SHOWING A WELL-LOCATED MUDCAP

Breaking Boulders

I have had excellent results in removing boulders and breaking them up with mudcaps. In Massachusetts, many boulders of granite formation, known as "hardheads," are found. They are usually round and smooth and frequently the larger portion of them is buried in the ground. They are regarded as a hard proposition by experienced blasters. If only a part of the boulder shows above the surface, I sound with a three-eighth inch steel rod five feet long with a sharp point and poker handle, to determine the size and position of the stone underground. I then place a relatively small charge of Red Cross under one end or one side, the discharge of which rolls the boulder out upon the surface of the ground. It then takes a small charge of Red Cross to completely shatter it. I frequently dispose of the pieces by placing them back in the hole, thus saving the expense of carting them away. There is usually room in the hole for all of the pieces and still allow for eighteen inches of top soil over them.

WINTHROP FILLEBROWN.

Largest Boulders Successfully Blasted

I am sending you a photograph of a rock which weighed between six and eight tons. As shown by the picture one man could handle any piece of it after the blast. The farmer for whom this blasting was done had spent for labor from $50 to $60 in clearing five or six acres of small boulders. I cleared about as much for $8 by using Red Cross Dynamite.

W. H. NANGLE,
Thorndale, Texas.

NANGLE'S BOULDER

Ditching

Ditches of some sort are needed on almost every farm or ranch. In some cases the soil is too wet and the excess water must be carried away; in others, it is too dry and more water must be brought to the field. Much irrigated land needs drainage for the relief of alkali and bad seapage conditions. The roads and railroads need drainage to prevent rapid deterioration. Each condition requires more ditches.

LOADING A DITCH AT WALLOWA, OREGON

The enormous amount of land too wet for agricultural purposes is realized by but few. There are more than 3,000,000 acres of farm land that needs drainage on the Pacific slope alone. To drain this will require hundreds of thousands of miles of ditches.

The same need for new ditches is felt on the irrigated lands, both on the new developments and on the older ones where the original irrigating systems are either inadequate or poorly located.

These varied conditions call for different methods of relief. Ditches varying all the way from the tiniest tile drain to huge canals large enough for navigation are needed. The methods of digging vary as much as the work to be done. Each method has its own peculiar use under conditions where other methods are not suited.

The use of dynamite is recommended for digging open ditches from a few feet wide to as much as 16 feet wide and 6 feet deep. This recommendation is made because the blasting of ditches has been successful under all conditions, from the softest swamp mud to the hardest rock, with the single exception of ditches in loose, dry sand. The actual conditions where dynamite is found most successful for ditching are; swampy and rough land, locations where labor is high, where large amounts of digging must be done in haste, and in hard ground.

When a ditch is blasted there is no outlay for expensive equipment, because the only equipment necessary is a steel bar, pointed at one end. In hard ground, a sledge is needed to drive the bar down to the necessary depth. There is no delay and expense getting machinery into place through swamps and thickets. Not even a team is needed when ditches are dug with dynamite, for one or two men can easily carry sufficient dynamite to dig a ditch four or five hundred feet long, four or five feet wide, and three or four feet deep.

When ditches are dug with dynamite the material to be taken from the ditch is thrown out by the blast, and little or no shoveling is necessary. This material is not heaped up along the sides of the ditch, where it would occupy land that should be raising crops, and would prevent free drainage into the ditch, but is spread evenly over the ground for a considerable distance on each side of the ditch.

Ditches can be dug with dynamite at any time on short notice, as dealers who handle explosives can be found in almost every locality. In wet weather, especially after heavy rainfalls, when it may be necessary to cut ditches and channels in a hurry, this method is invaluable.

It is just as easy to dig a curved ditch with dynamite as it is to dig a straight one, because the center of the ditch follows the line of holes in which the dynamite is loaded.

Methods of Ditching

There are two distinct methods of blasting ditches for drainage and irrigation; the propagated and electric. The propagated method can be used only in wet soils, while the electric method can be used in either wet or dry soils. The explosives and blasting supplies needed and the methods of loading vary considerably in the two methods.

BLASTING A DITCH AT WALLOWA, OREGON

In the propagated method of ditch blasting, soil conditions are sometimes encountered that along the line of the ditch there will be imbedded in the soil, below the surface, boulders or logs which will interfere with the proper transmission of the propagated method of blasting. Where such obstructions as boulders and logs are encountered, it is advisable to remove these before depending on a propagated blast to make the ditch. Better still, under such conditions, of soil, to use the electric method of blasting.

Among the most striking advantages of ditching with dynamite, as compared to other methods, is the reduction in cost, the absence of a large soil pile along the ditch, the little time required, the absence of overhead expenses for equipment, the ability to dig successfully where the conditions are too bad for other methods, the adaptability to both large and small ditches, and the simplicity of the methods.

Ditching in Saturated or Mucky Soils Without a Blasting Machine

In wet soils, where holes two feet deep will stand half full of water, the quickest and generally the most economical method of ditching is with Du Pont Straight 50 per cent. dynamite. *Only a straight dynamite can be used for this work, as other grades are too insensitive to be detonated by the shock from a single primer in a central hole.* This can be practised in the roughest of swamps, even where there are several inches of water standing on the surface or where the surface is covered with the heaviest of swamp stumps.

This class of ditch blasting should not be attempted when either the air or water is colder than 50 degrees F.

The simplicity of the method and the truly wonderful results obtained must be seen to be fully realized.

The course of the ditch having been decided on by a survey or close study of the slope, as indicated by the surface drainage and the trees having been chopped from the right of way, the work may be begun.

This method of ditching is applicable in draining wet lands and correcting streams.

Test Shots

The first thing to do is to try a few trial shots to ascertain the best depth and spacing for the holes. For ditches up to 3 or 3½ feet deep the depth of bore holes will usually be about 24 to 30 inches, and the spacing between holes from 18 to 24 inches, although it may be necessary to increase the depth and decrease the spacing in some cases. It is well to begin the test with holes two feet deep and 18 inches apart. Keep these in line and load about 10 of them with one cartridge each. If a little water covers the cartridges in the holes no further tamping will be needed. If not, tamp well with earth. After the entire line is loaded, one hole is charged with an extra primer cartridge, and it is also well to put one additional cartridge in each hole adjoining the primer.

This loading should lift the soil many feet into the air, scatter it over the adjoining swamp for a distance of 150 feet and leave a good, clean ditch. If it does not, try a different loading. It may be necessary to make the holes deeper in some soils and not so deep in others. Usually in swamp soils the ditch made is a foot to two feet deeper than the charge, but sometimes it is necessary to load to the full depth.

If the test shot makes too large a ditch, the spacing can be increased a little, but should seldom be greater than 24 inches, and then only in warm soil. For very small ditches less than a full cartridge of explosive may be used in each hole.

Amount of Charge and Size of Ditch

Small ditches (for instance, about two feet deep and three feet wide) in such soils, when there is little trouble from roots, can be dug with half cartridge charges, but when using such small loads the spacing between holes can seldom be over 18 or 20 inches.

Larger ditches can be dug by using two or more cartridges in each hole, and a second, or even a third line of holes may be put down about four feet from the original line and loaded in the same way. When two or three lines of holes are used it will be necessary to use one electric cap in each line, or to put in one or two extra charges between the rows to insure the simultaneous detonation of all the charges.

THE FINISHED DITCH AT WALLOWA, OREGON, 8 FEET WIDE AT TOP, 4½ FEET WIDE AT BOTTOM, 3½ FEET DEEP. THE COST, INCLUDING LABOR, WAS 6½C. PER FOOT

Approximate Table of Charges of Du Pont Straight 50% Dynamite for Blasting Ditch Without a Blasting Machine

Top Width of Ditch	Approximate Number of Cartridges Per Hole Required for Ditches of Various Depths				Number of Parallel Rows Required	Distance Between Rows in Inches
	2½ to 3 ft.	4 ft.	5 ft.	6 ft.		
6	1	2	3	5	1	..
8	1	2	3	5	1 or 2	30
10	1	2	3	5	2	36
12	1	2	3	5	2	42
14	1	2	3	5	2	48
16	1	2	3	5	3	36
18	1	2	3	5	3	42

Distance between holes in rows 16 to 24 inches to be determined by 3 or 4 test shots. It is impossible to specify exactly, because soil conditions differ greatly, which makes a difference in spacings and loads.

Putting Down the Holes

Ordinarily in swamp soils the bore holes can be put down with little effort. If the soil is at all hard, or has a heavy crust, the fastest tool is a good sharp crowbar, but if soft and mucky, a heavy tamping stick will suffice. The holes should not be left open, but should be loaded at once, as they will cave in or be filled with floating slime.

Amount of Dynamite Required for a Given Length of Ditch

In order to enable the blaster to calculate the amount of dynamite required to cut various size ditches, the following table used in conjunction with either of the preceding tables should prove very useful:

Spacing between holes in row	10 Rods			¼ Mile			½ Mile		
	Number of holes	Dynamite required using charges per hole of		Number of holes	Dynamite required using charges per hole of		Number of holes	Dynamite required using charges per hole of	
		½ cartridge	Whole cartridge		½ cartridge	Whole cartridge		½ cartridge	Whole cartridge
18 ins.	110	28 lbs.	55 lbs.	880	220 lbs.	440 lbs.	1760	440 lbs.	880 lbs.
20 "	99	25 "	49 "	792	198 "	396 "	1584	396 "	792 "
24 "	83	21 "	41 "	664	166 "	332 "	1328	332 "	664 "
26 "	76	19 "	38 "	608	152 "	304 "	1216	304 "	608 "
28 "	71	18 "	36 "	566	142 "	284 "	1132	283 "	566 "

1 rod — 16½ feet.
10 rods— 165 feet or 55 yards.
¼ mile—1320 feet or 440 yards or 80 rods.
½ mile—2640 feet or 880 yards or 160 rods.

For larger ditches requiring heavier loading or several parallel rows of holes increase the total amounts accordingly. These amounts also apply to ditching with a blasting machine.

Ditching With a Blasting Machine

While it is possible to blast ditches by the propagated method, that is, without blasting machine, only in wet soils, the electric method can be employed in any class of material, dry sand excepted, and low strengths of low-freezing Red Cross Dynamite or Du Pont or Repauno Stumping Powder can be substituted for the more sensitive straight dynamite.

The layout of the ditch is exactly the same as for the other method, but as an electric cap is used in each hole it is possible to space them farther apart in the row. The normal distances are from 24 to 32 inches for small ditches, and up to 48 and 52 inches for large ditches.

Different Explosives for Different Classes of Work

The explosive selected for electric ditch blasting will depend upon the soil and size of ditch. In a medium loam, where only a small ditch (for instance, two feet deep and three feet wide) is desired, the selection may be Du Pont or Repauno Stumping Powder, Red Cross Extra 30 or 40 per cent. dynamite. Where the material is sandy Du Pont Gelatin 40 per cent. will give best results. It is practically impossible to blast ditches in dry sand.

For larger ditches, or where there is much trouble with stumps and roots, a stronger explosive will give more economical excavation, and Red Cross Extra 40 per cent. or Du Pont Gelatin 40 per cent. should be selected. Where the work is very wet, and the charges must be left in the water for a long time, the gelatin should be selected, as it is more water-resisting than the Red Cross Dynamite.

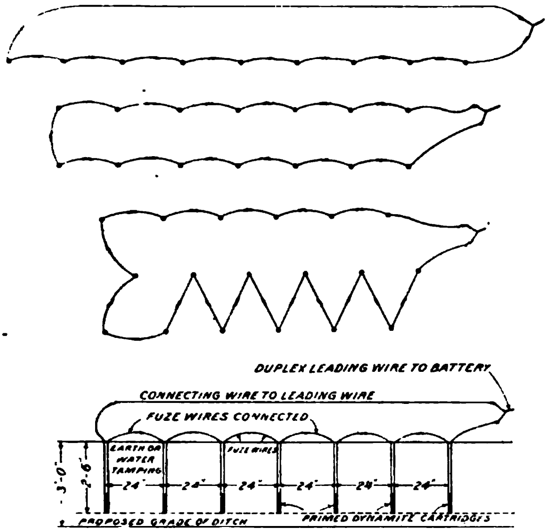
Methods of Loading

After 3 or 4 trial shots similar to those described for wet ditching have established the proper depth and spacing of the holes, and the amount of dynamite per hole, the blaster is ready to begin actual operations. The holes may be put down with a subsoil punch, crowbar, soil auger, or any other tool suitable for the particular class of soil.

Unless water covers all charges they should be thoroughly tamped. It is best to punch only enough holes for one blast, load them and fire, before putting down more, as they are likely to be filled up or covered with trash thrown up by the blast. Do not overload the blasting machine. If its rated capacity is thirty charges, do not attempt to fire more than that at a time.

When only one cartridge is used in a hole it must contain the electric cap, and should be pressed well down to the bottom of the hole and tamped so that there is no air space left to reduce the effect of the blast. When several cartridges are used in each hole, the primer should be on top, with the cap pointing downward.

As the work progresses the soil should be carefully watched, and any needed variation made in the loading so that it may always conform to the material to be lifted.



Method of connecting up one line of holes.

Method of connecting two lines of holes.

Method of connecting three lines of holes.

Showing how the wires are arranged for electric ditch blasting.

METHODS OF CONNECTING WIRES FOR ELECTRIC DITCH BLASTING

Blasting Large Ditches With a Blasting Machine

When larger ditches are desired the loading may be in deeper holes, using more or a higher strength of explosive; or one or two more parallel lines of holes may be employed, especially where wide but shallow ditches are needed. Where very deep ditches are needed, blast a wide, shallow ditch with two or three parallel rows of holes, and then load one or two rows in the bottom of the shallow ditch, and blast another ditch in the bottom of the first one. This latter method has been very efficient in opening large ditches eight or nine feet deep through heavy bottom lands for the correction of stream channels.

Stream Correction

Each rainy season the big freshets in creeks and rivers are the cause of much property loss. Bottom lands are either washed away or covered with a layer of sand that is too deep to plow under, and the fertility of the soil is greatly reduced.

Permanent control of streams subject to overflow is expensive if undertaken in haste. Equally good results may be obtained with much less expense by undertaking the work in a slower but more systematic way, which will permit the stream to do most of the actual digging itself.

A great part of the filling up of stream courses is caused by logs and other floating material forming rafts and sand bars in the channels. Another fruitful source of trouble is from outcrops of rock which divert or impede the normal flow of the current. Overhanging stumps and trees along the banks lend still further obstruction. Sharp bends in the course of the stream check the current and cause trouble by forming sand bars.

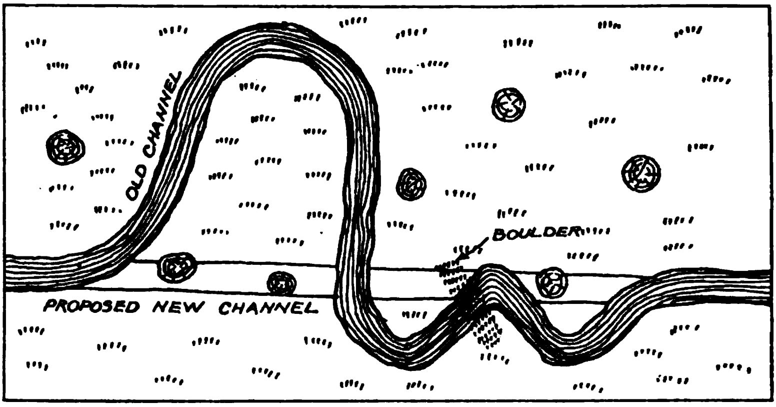


DIAGRAM OF STREAM TROUBLES THAT MAY BE CORRECTED BY BLASTING

Any and all of these troubles may be overcome quickly and at reasonable cost by the use of dynamite. Shoot out the rafts and logs, and blast a sufficient channel through the confining rock. A well-placed blast will cause the overhanging stumps to immediately vacate.

The cutting off of sharp turns in the channel will take a little more time and should be well done in the beginning. Locate the line of the new cut-off and blast a ditch that will at all times carry a part of the flow. When this is done and the rafts and logs are out of the way above and below, all there is left to do is to wait for the heavy rains to flood the streams. The increased rate of flow will cause the water to cut and wear away at the bottom of the channel as well as at the sides. From time to time it will be best to go over the stream and make sure that no new obstruction is being formed.

Small blasted ditches have been scoured out by the current until they are now carrying the entire flow of large streams. With a little help now and then any stream with a fair fall can be made to do wonders in making itself a permanent and suitable course.

Table of Charges for Electric Ditch Blasting

Approximate Top Width of Ditch in Feet	Approximate Number of Cartridges of Red Cross Extra 40% Dynamite Required for Various Depths			Number of Rows of Holes Required	Distance Between Rows
	2½ to 3 ft.	4 ft.	5 to 6 feet		
3	1	..	..	1	0 inches
6	2	4	6	1	0 "
8	2	4	6	1 or 2	20 "
10	2	4	6	2	28 "
12	2	4	6	2	36 "
14	2	4	6	2	42 "
16	2	4	6	3	42 "
Required length of No. 6 Du Pont Electric Blasting Cap Wires	4 ft.	6 ft.	6 to 8 ft.		

Although this table is necessarily but an approximation, it will serve as a good basis for estimating ditch charges.

Practice makes perfect in ditch blasting the same as in anything else. The way to get the practice is by blasting short test sections of about ten holes each until the proper loading for the soil condition is determined. After blasting a few ditches, less experimenting in the beginning will be necessary.

Liked the Sample Ditch So Well. Did More of It

A Propagated Blast

Mr. A. L. Jones gave us a practical demonstration of the efficiency of your powder for ditching. I have adobe soil black and wet. We spent about an hour punching and loading holes 3 feet deep with 42 pounds Du Pont Straight 60 per cent. Dynamite. We opened a reasonably clean ditch 85 feet long, 6 feet wide on top and 3 feet deep.

Being pleased with the economy of it, I immediately placed an order with my dealer for more Du Pont Straight 60 per cent. with which to continue the work.

F. L. CHAMBERS,
Eugene, Oregon.

A Hard Problem Solved

An adverse condition was selected in swamp land for a demonstration of ditching with dynamite before a large drainage association. The soil was a sandy muck saturated with water, and laced together with a luxuriant growth of roots. The surface was studded with large green stumps. The location was selected because the managers considered it an impossible undertaking. An idea of the conditions can be gotten from the accompanying illustrations.

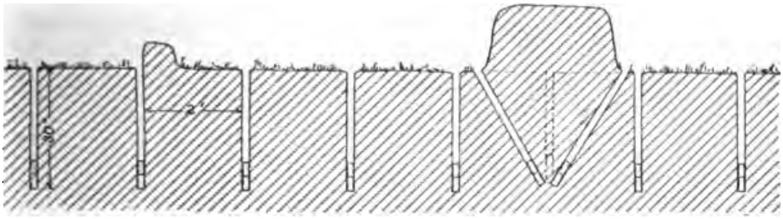
LOADING THE DITCH

A SHORT TEST SHOT

The line of the ditch was laid off with a light cord. Holes were punched along this, spaced 2 feet apart, to a depth of 30 inches. Each hole was loaded with 2 cartridges of dynamite; one 60 per cent. Du Pont Straight, the other 40 per cent. Red Cross Extra. A few extra cartridges were put directly under the larger

THE FINISHED DITCH

stumps. The blast was fired by the propagated method, using only one cap to each section of ditch.



METHOD OF LOADING THE BLAST, USING EXTRA CHARGES UNDER LARGE STUMPS

The result was a clean ditch 9 feet wide and 3½ feet deep, with a bottom almost absolutely true to the desired grade, at a cost of less than 10½ cents the cubic yard. The minimum estimate for hand labor on this job was 25 cents the yard, and it is quite unlikely that the work could have been done at this price. This blasting was later continued on a commercial scale.

Ditching in Heavy Sod

A FINE DITCH IN IDAHO

Herewith find photograph of a ditch made through brushy swamp land by using 1½ x 8-inch cartridges of Du Pont Straight 60 per cent. Dynamite, spacing the holes 20 inches apart. A passageway, wide enough for the person planting the powder, was made along the path of this ditch. The ditch averages 9 feet in width at the top and 4½ feet in depth and is very cleanly cut.

One part of it which does not appear in the picture was made through 24 inch thick, tough swampy sod. The sod was opened up and rolled back like a huge hide. After the shooting, the sides looked like two giant plow furrows of 5 feet width each one laid to each side.

LEWIS GRINDE,
St. Maries, Idaho.

Endorsed by Experiment Station

We have done some remarkably efficient ditching work at a small cost (compared to teams and pick and shovel) by using Du Pont. I have in mind a piece of ditch 50 feet long, 6 feet wide, and 3 feet deep, which was dug at a cost of 12¾ cents per cubic yard. An argument that greatly favors using Du Pont in this particular kind of work is that no water-holding banks are thrown up, resulting in almost perfect surface drainage. Another feature greatly in favor of using Du Pont in ditching is the rapidity in which it can be done. When the ground is wet and heavy, and farming operations are at an enforced standstill, then is the time to do the best work in ditching—*with Du Pont.*

PAUL D. PERKINS,
Supt. Angleton Station.
Texas Agricultural Experiment Stations.

Tile Drain Made Effective by Blasting

I shot 35 acres of swamp land which in former years was covered with water, many places standing a foot deep. Although there was a drain through the field, the water would not disappear because of impervious material between main drain and swamp land. The object of shooting was to break up this impervious material so that the water would drain through from swamp land to drain.

The regular method of digging a drain or several laterals from bogs to main drain would have cost me $400. Blasting with Du Pont only cost me $47, and my land has increased in value from practically nothing to $125 per acre.

W. J. SNODDY,
Billings, Mont.

LOADING THE DITCH

BLASTING DITCHES THROUGH A SWAMP

Drains 20 Acres in 10 Hours

E. I. du Pont de Nemours & Company.

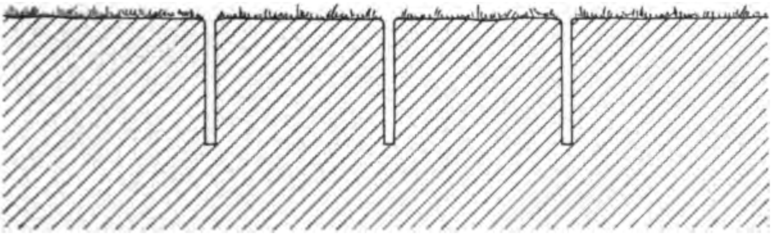
Gentlemen—Through a piece of bog meadow we blasted some 500 feet of ditch in about 10 hours, 3 feet deep, 3 to 4 feet wide, which serves to drain some 20 acres. The use of Du Pont Straight 60 per cent. Dynamite placed in holes 2 feet apart and but 18 inches deep gave us the result. A greater depth than 18 inches gave us a deep hole but not as good result. We are using Du Pont Straight 60 per cent. Dynamite daily for various kinds of farm work with the use of a battery and several charges and have done excellent work.

Respectfully yours,

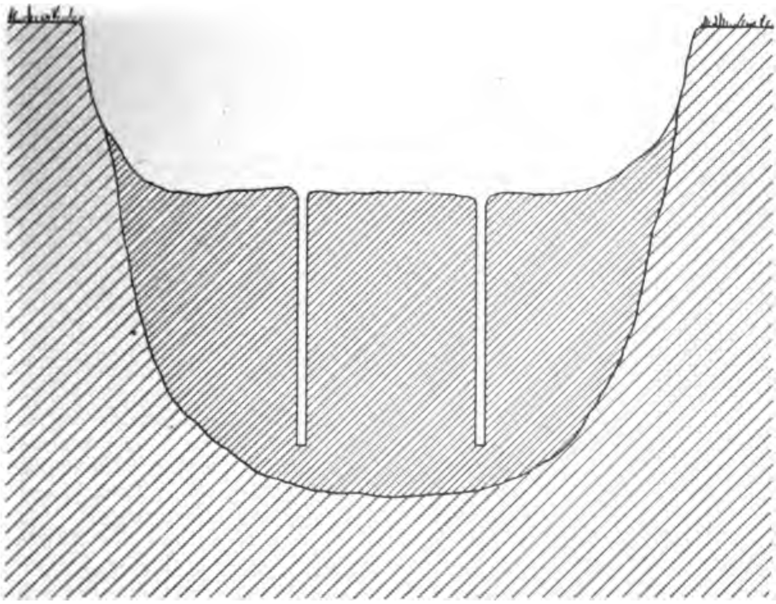
F. SCHROEDER.

Large Ditch Successfully Blasted

At the 1913 meeting of the North Carolina Drainage Congress an effort was made to straighten a creek. The ditch needed was eight feet deep and 18 feet wide. The surface soil was light and full of roots. The subsoil was a heavy, wet clay. Three rows of holes were put down to a depth of from 30 to 36 inches, spaced four feet apart and loaded with Red Cross 40 per cent. The blast removed the soil to a depth of about 30 inches. In the bottom of this shallow ditch two rows of holes were put down, spaced four feet apart, to the desired depth of ditch and loaded a little more than half full of 40 and 60 per cent. Du Pont. This blast threw out the soil to the desired depth and left the completed ditch fully up to the desired size, 8 x 18 feet. The cost was between 12 and 13 cents the cubic yard, which was a little high for the work, as the loading was too heavy.



SECTION OF DITCH SHOWING HOW THE FIRST LOADING WAS DONE



SECTION SHOWING THE BOTTOM LOADING AND THE AMOUNT OF DIGGING DONE BY EACH LOADING the blasting was done washed out all of ground loosened by the blasts and permanently and satisfactorily corrected the channel and reclaimed the wet land. The man on the bank is pointing in the direction of the old channel.

Straightens Creek With Dynamite

YALMAR, MICH., September 21, 1911.

The ditching proposition hit me the most, and would never believe until I saw your men do it here, as the creek was making all kinds of turns and swings and cutting my farm up in an awful shape, and I could have had it done long before this if I had only known how, and with a great deal less labor and at half cost than to do it with a team and scraper. Even then it would have been very hard to get it done on account of all the roots and big stones there are in places which were easily shot out with Du Pont.

The ditch they shot here, to my measure, was 80 feet long and seven feet wide, and three and one-half at bottom, three and one-half feet to four deep, with the cost of $2.25, which would cost me close to $1.25 per rod if I was to have it done with team and scraper or with a shovel.

CHAS. WILSON.

Correcting a Small Stream

The above is a view of a correction made in the course of a small stream. The original channel was not satisfactory in that it did not discharge the flood water fast enough to prevent flooding an area of bottom land.

The electric method of blasting was selected and perfect excavation was secured. The new channel is entirely satisfactory. The ground was quite hard but no hand work was required to complete the ditch.

Successful Ditching on Farm of Editor of American Agriculturist

NEWBURGH, N. Y., July 18, 1911.

The blasting demonstration on my farm last week was an emphatic success. The ditching was a complete surprise to everybody. The explosive certainly did the work and made as pretty a ditch as ever I saw.

C. W. BURKETT.

DR. BURKETT'S DITCH A FEW MINUTES AFTER THE BLAST

Blasting Cheaper Than Digging

Blasted a drainage ditch for a distance of 120 rods at a cost of 43 cents per rod. The ditch was run through an old creek bottom where the ground was wet, but cross cuts were made through high dry banks, for the purpose of straightening the course. The results of this ditching were very satisfactory, the results on high ground being equally as good as on the low ground.

It would be impossible for any man to dig as good a ditch as we got, three feet by four feet, at a cost of 43 cents per rod, in the kind of soil we went through, unless he used Du Pont explosives.

JOSEPH WOLFE,
Ewen, Mich.

Does Four Days' Work in Three Hours

LONDON GROVE, PA., November 6, 1911.

I am pleased to advise that I have used Red Cross for draining swamps on my property, reclaiming about one-eighth of an acre, which has always been unproductive. This is now pasture land.

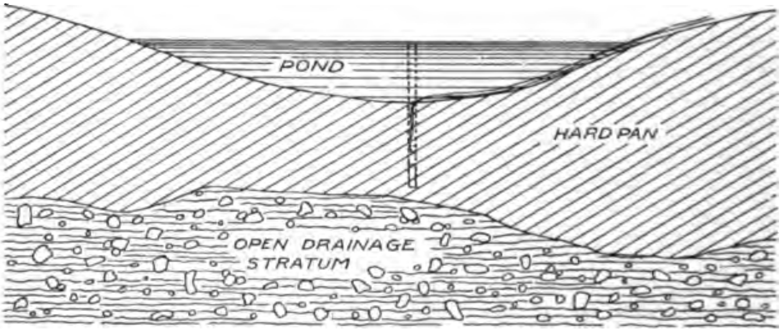
This land was drained by ditching, and I found the use of Red Cross for this work less than one-third the cost of digging by hand and then hauling away the dirt. The time consumed in ditching with Red Cross required about three hours for one man, and by the old method of digging it would have taken one man at least four days. This would have left dirt on the ridge along the drain, whereas by using Red Cross it was distributed evenly along the sides.

T. S. GROFF.

Underdrainage of Wet Spots

It is sometimes very difficult to devise a method of draining a depression. Generally speaking, ditching is the proper solution of the problem, but that calls for an outlet and at least some degree of slope.

Ponds and wet spots are caused by impervious soil beneath them. By blasting this impervious stratum, perfect drainage can sometimes be brought about. Certain conditions must prevail, however. First, it must be ascertained by means of a soil auger that there is a stratum of gravel or sand beneath the impervious layer that will carry off the surface water if it is drained down into it.



WHEN PONDS ARE CAUSED BY TIGHT MATERIAL OVER OPEN MATERIAL THEY CAN BE DRAINED BY DEEP BLASTING

The character of the soil type forming the impervious layer must also be noted. If it is shale or a true hardpan that will remain broken up when blasted, the blasting alone, provided it breaks all the way through to the water-carrying stratum of sand or gravel, will prove sufficient to drain the surface.

On the other hand, if the impervious layer consists of a fine sticky clay, it will run together again, if blasted, and the drainage will stop because of the clogging of the outlet. When these conditions prevail, a bore hole should be put down to within about a foot of the underlying stratum of sand or gravel. If this stratum lies over thirty feet below the surface, this method of drainage is impractical. At the bottom of the bore hole a chambering shot should first be made by using a cartridge or two of dynamite. In the chamber thus formed a load of from five to twenty-five pounds of 40 per cent. dynamite (the amount depending upon the depth of the hole) should be placed. Cartridges should also be strung all the way up the bore hole to within about two feet of the top. As the cartridges will all be in contact with one another, one primed cartridge at the top of the line will fire the entire charge. The object is to blast out a well or sink hole. Such a shot should form a vertical well from the surface down to the sand. If the soil is of a wet, heavy, clay type, it should not cave much. This well or sink hole should then be filled with cinders, loose stone, stump fragments, or some other material that will prevent the clay from running together again. Such a sink hole should drain the pond or wet spot.

The hole should be put down at the lowest point in the surface; that is, the point to which surface water would naturally run. If the wet spot is a large one covering considerable area, it will probably be necessary to make several sink holes in the bottom in order to get desired drainage.

In order to determine the depth required, a test hole is bored with a dirt auger, which should be pulled up from time to time in order to clean the hole out, and also to ascertain the nature of the soil encountered, which is readily seen on the spiral thread of the auger. Once the water-absorbing sand or gravel is reached the depth of the hole is noted on the auger shank. This test hole may be tamped full of soil to about 6 inches above the sand or gravel in shallow holes, and 12 to 18 inches in deep holes. This is done because it is not advisable to load the charges in the sand or gravel. They should be located in the hardpan stratum.

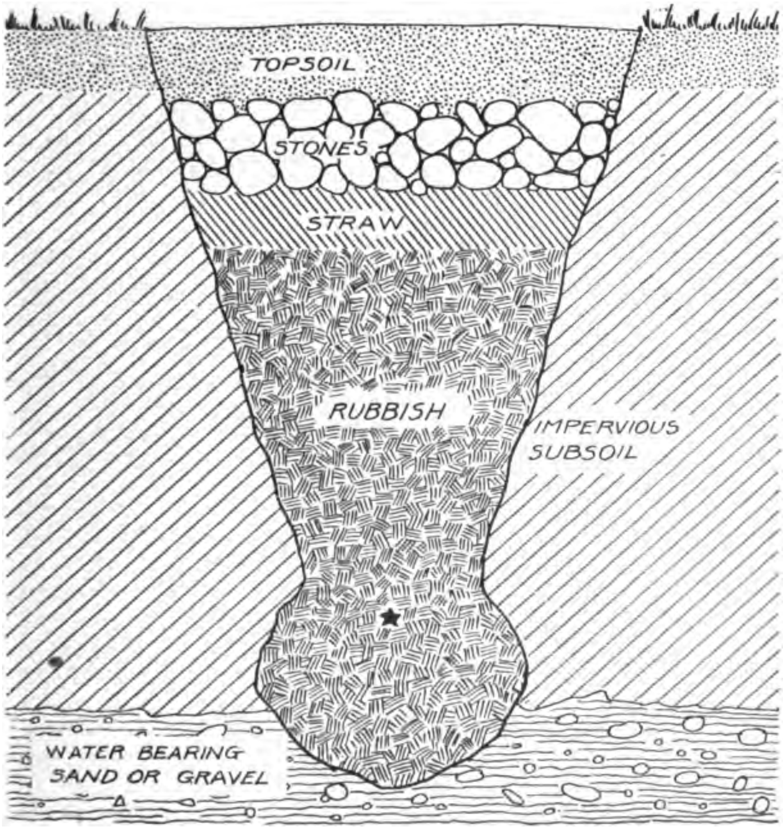


DIAGRAM OF DEEP DRAINAGE HOLE, SHOWING THE USE OF TRASH TO PREVENT THE HOLE BECOMING CLOGGED WITH FINE CLAY

It very often happens that holes have to be bored to depths averaging from 15 to 30 feet before the water-absorbing strata are reached and in order to do this it is necessary to use an extension auger or long churn drill. If the water is too deep to work in, the boring should be done from a raft. It is much easier to operate the auger through a hole in the center of the raft than over the side. As soon as the hole has been bored to the required depth the auger is withdrawn and a piece of 1½-inch pipe sufficiently long to reach the bottom of same and 5 or 6 inches above the water level is inserted. Through this the dynamite cartridges are dropped one at a time and pushed to the bottom with a wooden tamping rod. A good firm push will hold each cartridge in position. The last cartridge but one is primed with a Du Pont Waterproof Electric Blasting Cap and one cartridge is put on top of it to hold same in place, as it is not advisable to give the primed cartridge too hard a push with the tamping rod.

When the hole has been charged the loading pipe is withdrawn and slipped over the ends of the electric fuze wires, the leading wires are connected on to the electric blasting cap wires, the joints being carefully protected with insulating tape and the raft is poled to the shore or a safe distance away from the hole while the leading wire is carefully paid out. The outer ends of the leading wires are then attached to the blasting machine, the operation of which explodes the charge. It is unnecessary to do any tamping in this work if the holes are filled with water. The cartridges should not be slit. The explosive to use is Red Cross Extra Dynamite 40 per cent., or Du Pont Gelatin 40 per cent. The following table gives the approximate charge for holes of different depths:

Depth of Hole	Approximate Number of 1¼" x 8" Cartridges
5 feet	5
10 "	12
15 "	20
20 "	25
30 "	40
40 "	50

Where the ground is swampy or ponds form in the wet season only and dry up later in the year, the blasting should be done in the dry season when a raft will not be required. This blasting should be done just as described above except that it is necessary to tamp the charge thoroughly unless the bore hole fills up with water.

It should always be remembered that the first and most essential feature of drainage is the control of the rainfall; that is, holding it in the subsoil by proper tillage where it can nourish the crops. If proper attention is paid to this feature better crops will be produced and the need of handling large amounts of excess water materially reduced.

Vertical Drainage for the Control of Alkali

Many acres of the most valuable irrigated lands are becoming worthless on account of the accumulations of alkali. An alkaline soil is one containing soluble material in an amount sufficient to retard plant growth. A large number of compounds are capable of forming alkali, but those ordinarily causing trouble are the sulphates, chlorides and carbonates of sodium, calcium and magnesium. They are formed by the breaking down of the soil particles into more easily dissolved material. In this way, alkali is being formed in all the agricultural soils regardless of the climate or rainfall.

In regions of heavy rainfall, harmful alkali is easily washed away, but in the drier regions where there is little or no drainage on account of the rain water being held by the soil and used by the plants or lost by evaporation, the alkali is allowed to accumulate and remains in part or entire.

Some of the alkali, however, is carried to lower levels by wind and by surface or sub-surface drainage following occasional rains. Where the transported alkali is left on the low lands by the wind storms or through seapage of alkaline water from ditches, canals or reservoirs, the trouble becomes more aggravated and may entirely prohibit the growing of crops.

On the higher plains many alkali spots are formed by surface run off washing the alkali into slight depressions, where the water is lost, in part or entirely, by evaporation and the soluble salts are left in the surface soil.

ALKALI FORMED BY BAD DRAINAGE. THIS HAS ALREADY BEEN DRAINED AND RECLAIMED

Along many river valleys the underlying water is very close to the surface and carries varying amounts of alkali. In places this water is being continually lifted to the surface and is lost, to a considerable extent by evaporation, leaving only the alkali on the surface. A continuation of this, of course, brings about a very destructive alkaline condition. In some of the older irrigated regions excessive irrigation on hill lands resulted in washing much alkaline material to the lower levels by means of sub-surface seapage.

Many remedies, such as scraping up and carting away objectionable salts, selection of resistant crops and application of foreign materials, have been tried for the correction of alkaline soils, but the one that has proven most successful is washing by means that approach as nearly as possible the action of heavy rains in more humid regions.

The object to be obtained in washing out alkali is to bring the salts into solution by using an excessive amount of water, and allowing it to pass entirely out of the way through sub-drainage, or forcing it downward with water percolating into the subsoil to a depth where it will not effect plant growth. When this latter method is practised it should be followed by good tillage to prevent the return of the alkali to the surface through strong capillary rise of moisture.

Ordinary heavy irrigation has not proven successful unless it has been assisted by something that will allow of easier downward movement of the irrigation water, or sub-drainage.

The installation of sub-drains has been attended with difficulties in many irrigated regions on account of absence of any suitable discharge or out fall for the drains; on account of the expense of installing drains; and on account of the regions remote from manufacturing plants being compelled to pay prohibitive prices for tile.

A more modern method is to loosen up the subsoil or underlying hardpan, that may be present, to a depth of four feet or more, depending on the nature of the underlying material, by the use of small charges of dynamite. This does not disturb the surface soil to any great extent, but opens drainage channels into the very deep material through which the wash water loaded with alkali can drain and percolate away.

An irrigation for such washing must be heavy and should be repeated from time to time. The subsequent irrigations, intended for crop growing, may follow in the usual way, and if not applied in too large amounts there need be no trouble from waste of expensive water.

When the depth through the hardpan to the open material beneath is too great for this method to be effective, deep holes may be blasted and filled with trash as is shown on page 43.

Blasting in the Orchard

A Proven Proposition

In 1910 the Du Pont Powder Company began to promote the use of explosives in planting new orchards and rejuvenating old ones. The idea was not original with us.

Nearly a quarter century ago, near La Mesa, Cal., ground was blasted for tree planting, because the orchardist found the work of planting with the spade in his resistant soil too difficult. His experiment was a success. The trees lived, thrived and bore exceptional fruit yields for many years, better, in fact, than those not so planted.

A FOUR YEAR OLD APPLE TREE IN A BLASTED HOLE, MELFORD, OREGON

Other orchardists and farmers in other sections of the country also thought of the same scheme for preparing a home for the tree roots. We have records of such plantings, eleven, sixteen and twenty years ago, before the idea really began to spread.

After we began to advertise it extensively and sent out demonstrators throughout the country, many farmers and orchardists tried the new plan on a small scale. Now, because of the universal success of correct blasting for orchard planting, the majority of fruit trees are being planted in blasted ground.

Millions of fruit, nut and shade trees have been planted in blasted ground long enough to prove the great advantages of the method. America's leading orchardists and nurserymen now plant exclusively in blasted ground.

No one can afford to plant trees by any other method except in soil that is loose and sandy to a depth of five or six feet. In such soil blasting is not advantageous except for the elimination of fungus and nematode troubles.

What Blasting in Orchards Accomplishes

1. It mellows the ground to a depth of five or six feet and throughout a circular area ten to twenty feet in diameter, making it easy to dig the hole and plant the tree correctly.

2. It creates a porous, water-absorbing condition in the subsoil that makes the tree drouth-proof, stopping the big, first year loss.

3. It makes root growth easy and makes tons per acre of new plant food available, hence speeds up the growth of the tree and makes it fruit one to two years earlier.

4. It creates drainage and prevents stagnation of water on surface.

5. In old orchards that were planted by the old methods and have ceased to bear well, it is of great value in rejuvenating the old trees, causing them to yield heavily.

6. It destroys fungus, nematode, and other orchard soil diseases, hence makes it possible to plant new orchards where old ones have been removed without waiting several years to rest the land and get rid of the diseases.

7. At a cost little or no more than of old-style planting, it causes at least a year's earlier return on the investment in new orchards, and greatly increased returns thereafter as compared with spade-set orchards.

8. It insures to the tree in all of its producing years a better degree of vitality—hence more fruit and better fruit.

Planting a Tree for Keeps

In studying comparative costs of planting fruit trees, the investigator is confronted with widely varying figures and methods.

There seems to be no machine for planting fruit trees such as a corn drill, but the method of some planters approximates the work of a machine in speed, if not in efficiency.

They lay off the site of the proposed orchard in 20-ft. to 40-ft. checks, depending on the kind of trees to be planted. Cross furrows are plowed through the field, marking it off in squares.

One man drives along a furrow with a wagon-load of trees, another lays a tree near each of the furrow intersections, and a third stands the tree in the intersections, kicks some soil over the roots, tramps it down, and moves on to the next intersection. This method expresses a touching confidence in nature, but results indicate such confidence is misplaced.

A tree that survives such treatment must have as many lives as the proverbial cat, and if it lives, how many years must elapse before it bears any fruit? What grade of fruit can be expected from a tree aged and bent with the fight for existence before it saves strength enough to bear at all?

Going to the other extreme we find a horticulturist advising: "Forget you are about to plant a tree and imagine you are going to bury a horse and dig a hole accordingly. Remember you can only plant it once, and its health and growth, the age at which it begins to bear, and the quantity and quality of fruit borne, depend chiefly on the care and thoroughness used in planting it."

Up to a few years ago, the method followed by most good orchardists was to dig a hole seldom as much as 2 feet in diameter and 18 inches deep, then plant the tree in top soil or a mixture of top soil and subsoil. Under this system the loss the first year ran from 25 per cent. to 50 per cent., depending on soil and weather conditions.

Then tree planting with explosives was taken up by a few orchardists who realized the shortcomings of the ordinary methods, and the necessity of cutting down first year losses, and speeding fruition.

The first objections to the new method were largely financial. The cost of explosives, blasting cap, fuse and labor ran from 8c. to 15c. per hole, whereas trees could be planted with a spade for 3c. to 5c. per hole. The trouble with this comparison is that the work performed is not the same, hence costs should not be compared.

The question involved is, how soon does the planter want a return from his investment and how large a return? The only way to compare costs is to consider the profit sought and which is the cheaper way to get it.

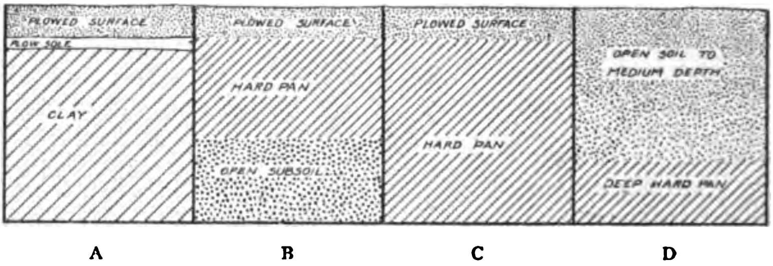
In the first place, the purpose of blasting is not to supplant the spade. It is possible to dig the hole with explosives, just as a hole may be excavated for a fence post. But the real object of blasting is to mellow the subsoil and make root growth and spade digging easy.

The places to set the trees or other plants being selected, mark them by a stake; or better, if the field is large, by furrows plowed to indicate the exact lines for the trees, and crossed at the proper interval by other furrows to indicate the spacing in the rows. Sometimes a heavy cord or light wire stretched across the field will materially assist in laying out the orchard.

Blasting for tree planting is best done in the Fall because it is easier to catch the subsoil in a dry condition, but blasting in the Spring for spring planting, although the subsoil is apt to be wet or damp, is nevertheless much better than planting in dug holes. It should be done as many days ahead of planting as possible, to get the effect of air and sunlight in the hole.

The exact nature and depth of the subsoil should be known in order that the explosive may be used to the very best advantage. The only way to know this is to go down and see. Do not stop at the surface but go down four or more feet. Using a good soil auger is the best and easiest way to test out a subsoil, but if one cannot be had, dig a hole. Another way is to blast out a test hole and examine each layer of the soil. This is not so good as the other methods as the blast so disturbs the subsoil that it is hard to tell just what the original condition was.

There are many different stratifications of the subsoil, but those illustrated by the drawings are the most common. If the arrangement of the soil is like that in illustration " A," place the explosive well down into the clay and destroy any shallow plow sole with a good plow. The best depth for blasting in such soil is usually from thirty to thirty-six inches.



DIFFERENT TYPES OF HARDPAN ENCOUNTERED IN THE ORCHARD

In soils like the one represented in " B," place the charge toward the bottom of the hardpan so that the entire stratum may be pulverized, but do not go below the bottom of it, as the force of the blast will tend to raise the hardpan in chunks rather than shatter it. The depth is governed absolutely by the depth of the hardpan.

Illustration " C," shows one of the most common subsoil troubles. This type of hardpan or tight clay is usually too deep to blast through and relief is obtained by pulverizing several feet of the top, which if well done will be found to be sufficient to store moisture and furnish room for an ample root development. For such a condition the blast should be made not less than three feet deep.

Occasionally a soil is found like that shown in " D," and will usually be found to require deeper blasting. The explosive should be placed well down in the hardpan—the deeper the better.

When very deep loading is practised it is best to increase the amount of the charge, sometimes as much as double the amount normally used.

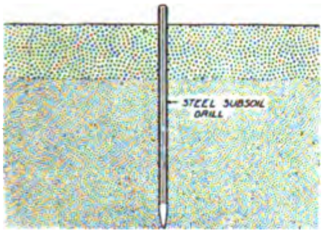
A number of different methods have been devised for making the bore holes for loading, but so far no other tool has given such good results as a heavy subsoil punch. This tool is made of 1½-inch steel and should be not less than three feet long. Smaller drills will not be satisfactory, as the explosive cartridge is itself 1¼ inches in diameter and when primed with cap and fuse is difficult to load into a smaller hole. The punch is driven to the desired depth, with a sledge, and loosened by pounding on the sides, after which it can easily be withdrawn.

PUNCH FOR MAKING THE HOLES

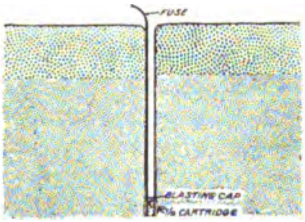
A soil auger is quite satisfactory for making a small number of holes, but is too slow and expensive if there is much work to be done. However, for holes deeper than three feet, one can be used very satisfactorily to deepen the drilled holes. In some cases holes can be made with a heavy crowbar. Some soils are so hard, being in reality soft rock, that a rock drill is required to make the holes.

The charge is prepared by cutting off a piece of fuse as long as the hole is deep, and crimping a cap on one end by means of a cap crimper. The cap with the fuse attached is inserted into the explosive used, and securely tied. See page 91 for methods of making up this charge.

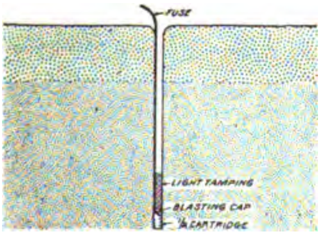
Start the charge into the bore hole and press it gently to the bottom with a wooden tamping stick. Pour in four or five inches of loose dirt and tamp it gently, then pour in more dirt, preferably slightly moist as it packs better, and tamp firmly. When the explosive is covered with several inches of lightly packed soil the rest of the tamping should be made as hard and tight as is possible, using the stick in one hand. The hole should be tamped full.



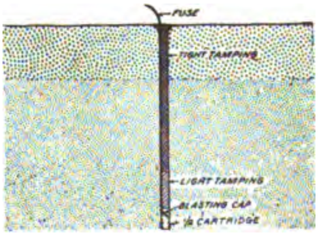
PUNCHING THE HOLE



THE CHARGE IN PLACE



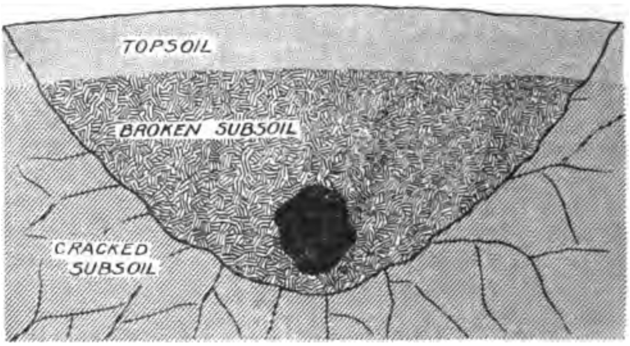
LOOSE TAMPING OVER CHARGE



TOP OF HOLE TAMPED TIGHT

The next operation is to light the fuse and retire to a sufficient distance to avoid any loose material that may be thrown out. If the loading is properly done and at a sufficient depth there is usually only a thud and a cracking at the surface and no soil is thrown into the air.

If the holes are blasted in advance of the time of setting the trees they are left without further attention until planting time, unless it is desirable to add some manure or fertilizer to be diffused through the soil. This is a good practice, especially on poor soil. If the soil is sour, sticky clay, a few pounds of lime scattered in the hole will materially assist in flocculating the clay and keeping it permanently granulated and sweet.



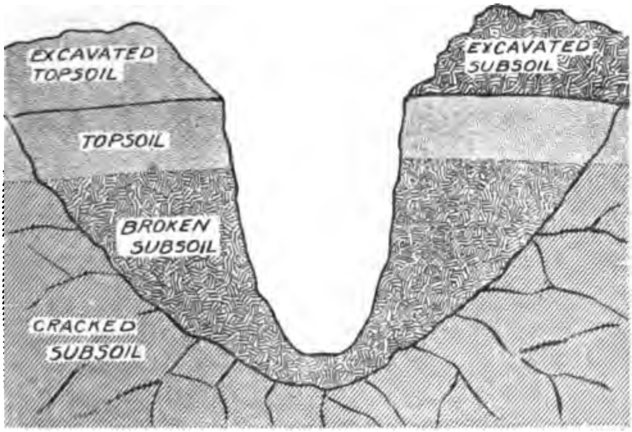
THE BLAST THOROUGHLY CRACKS THE SOIL, BUT USUALLY LEAVES A CAVITY OR POTHOLE AT THE BOTTOM. THIS MUST BE FILLED

When the trees are to be planted shovel out the hole and locate the cavity that is usually sprung at the bottom of the hole. Fill this with tamped soil to firm the base to prevent subsequent settling of the tree; fill the hole to the level it is desired to set the tree, being careful to keep the soil well tamped. Set the tree with the roots in as near their original position as possible and pack them with the top soil that has been shoveled out of the hole.

When no attention is paid to settling or firming the soil in the bottom of the hole, trouble often results from the tree settling too deep after the first heavy rains, but this trouble has never been observed when the holes were properly examined and the described precautions observed in setting the tree.

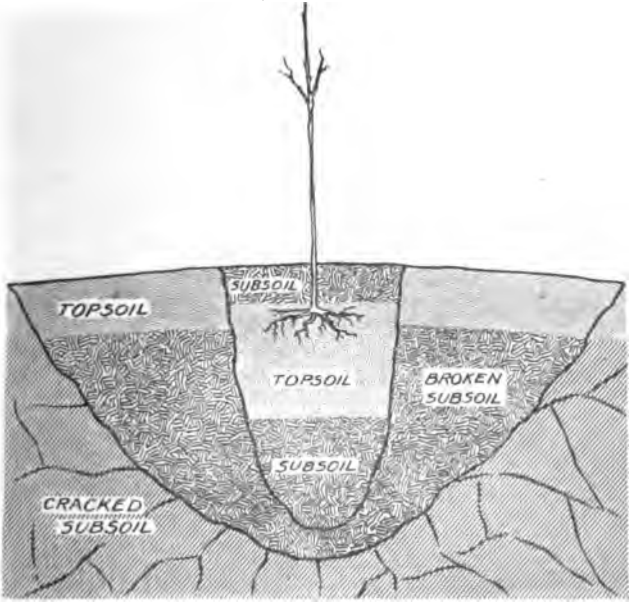
Just before packing the soil around the trees be sure that they are in line with the rest of the row.

When trees are set as much as thirty or more feet apart it is an excellent practice to place blasts midway between the rows after the trees have been growing several years. These will open up the subsoil between the trees that was but slightly disturbed by the original blasts and will induce more vigorous root growth, and consequently better trees will be the result.



THE BEST PRACTICE IS TO SHOVEL OUT THE LOOSE SOIL AND EXPOSE THE POTHOLE. THIS IS EASILY DONE IN THE FRESHLY BLASTED HOLES

It should be remembered that this method of resetting applies not only to orchard trees such as the apple and peach, but to nut trees, shade trees, berries, vines, roses and all classes of ornamental and commercial trees and shrubs, and is proving a money saver as well as a money maker.



AS MUCH OF THE HOLE AS POSSIBLE SHOULD BE FILLED WITH RICH TOP SOIL. PACK THIS ENOUGH TO PREVENT SETTLING AND SET THE ROOTS LIKE THEY WERE IN THE NURSERY

The Verdict of Practical Experts

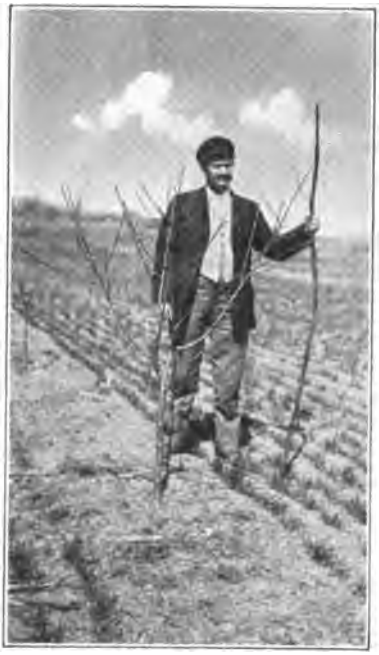
The true test of the value of any agricultural or horticultural theory is in commercial rather than experimental trials. The commercial orchardist or nurseryman adopts a new method not out of scientific interest, but because it pays.

Many theories seemingly proved sound in experiment station tests fail to stand up under the varying conditions of actual farming or orcharding. And likewise technical instructors and scientific investigators sometimes fail to recognize the merit of a new method until long after it has been adopted with success by the men who really lead in the industry or art.

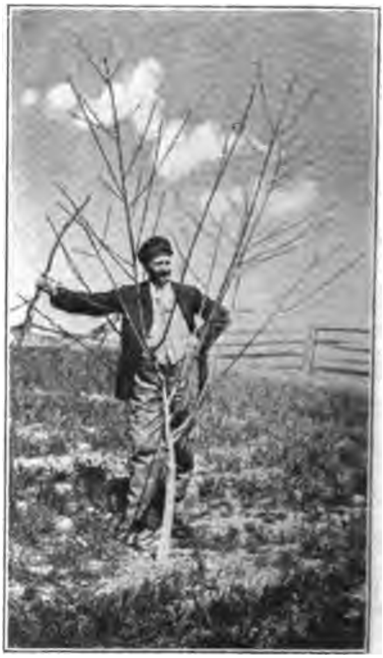
Thus, there are still some pomologists and soil physicists who are either skeptical as to the value of blasting orchard land, or actually deny its value. We do not question the sincerity of these gentlemen. Instead, we respectfully direct their attention to the overwhelming evidence of those who have to know as printed in this book.

To obtain incontrovertible proof as to the advantages to be derived from blasting for tree planting we directed questions to leading orchardists in all parts of the United States, to ascertain the conclusions they had drawn from practical field trials in young and old orchards.

A large number of replies were received. These supported all of our conclusions and claims which were based on our own experiments and demonstrations. Abstracts of many of these answers follow:



UNBLASTED HOLE



BLASTED HOLE

BOISE, IDAHO.

I used Du Pont Dynamite to break up hardpan and subsoil in planting my orchard, and feel it my duty to testify as to the results I have obtained in so doing.

In the Fall of 1912, I did the blasting and let the holes stand until Spring, when I had them settled with water and was sure that the cavities were well filled with earth, and knew that there was a good under drainage. The trees were then planted and given the usual cultivation. I gave the orchard a light irrigation the first of July and did not irrigate again that season. The trees had plenty of moisture and grew until late in the Fall, throwing out branches from two to four feet. Owing to the trees being small, and without much vitality, the growth was considered marvelous.

I attribute the growth to the fact that in blasting a reservoir was made for water to supply the trees, and the pulverising of the soil unlocked the plant food in the earth, which was dissolved by the moisture in the reservoir, and placed in a form so that it could be taken in by the roots of the trees. The trees this season have made a marvelous growth, and I do not expect to irrigate them more than twice this season.

If you wish to refer anyone to my experience, I will gladly testify as to the results I have seen in my own orchard.

Very truly yours,

T. A. JOHNSON.

Liberty Orchards Growers of Fine Rogue River Valley Fruit

MEDFORD, OREGON.

Du Pont Company.

Gentlemen:—You will be interested in knowing the results of experiments that we have made in "Plowing with Dynamite" for orchard cultivation. This was a departure in this valley from the old custom and its success justifies us in writing you so you may give the results to other people who may be equally benefited.

We found that after years of the old style cultivation there was a crust about a foot below the surface that was very hard to penetrate and under this crust

LIVING WITNESSES OF THE BENEFITS OF BLASTING IN THIS ORCHARD rich, loose soil. The writer conceived the idea of boring holes some 24 inches deep and using your powder to break up the ground. The effect was, after using three-fourths of a stick of 20 per cent. powder, a hole about the size of a small tub. Instead of this hole being encrusted and the soil packed as some prophesied, we found it, while circular in shape, filled with cracks quite large and running laterally. The effect was that in the rainy season, although the holes more or less filled up with soil, the water made it so soft that to step into a hole meant to sink to the knee. These laterals acted as conductors of water, practically from tree to tree, and the result was all Summer, not only was the ground loosened and the roots permitted to spread more freely, but the water was conducted along these cracks and the moisture conserved during the whole season. The holes were bored in the center of each square between four trees, and the result of this experiment was fruit not only more highly developed but more of it per tree than had been grown heretofore.

Any part of this letter that you may wish to use in the interest of orcharding, with which the writer is closely associated, will be free for your use.

Yours truly,
LIBERTY ORCHARDS,
By J. H. Neustadt, Owner.

A COMPARISON. THE LARGER TREE WAS PLANTED IN A BLASTED HOLE. THE SMALLER ONE WAS NOT SO FAVORED. EXPERIMENTAL ORCHARD OF JOHN TWOHY, MERLIN, OREGON

Proper Orchard Drainage Due to Blasting

As it is generally known, this section has considerable hardpan at various depths below the surface. In order to make good seapage, it is necessary to break up this hardpan, and in my estimation powder is the only thing that will do it. In fact, this Spring I used some of your Du Pont Stumping Powder with entirely satisfactory results. It is my intention to use more of it this coming Spring, both for breaking up hardpan and putting in a ditch on the lower side of my orchard. You have my permission to refer any others to me that are contemplating using powder for orchard work.

A. F. JAEGER,
Zillah, Wash.

Du Pont Stumping Powder the "Only Thing"

This Spring I bought some of your Du Pont 20 per cent. powder for breaking up hardpan in my orchard, with the result it did it to my entire satisfaction. The trees on which I tried it were four years old, and show this year a much better growth than previous years.

In my estimation, powder is the only thing that will give trees subsoil drainage, and you have my permission to quote me to anyone asking information.

ULRICH C. JOHNSON,
Zillah, Wash.

VIGOROUS YOUNG MAPLE IN BLASTED HOLE

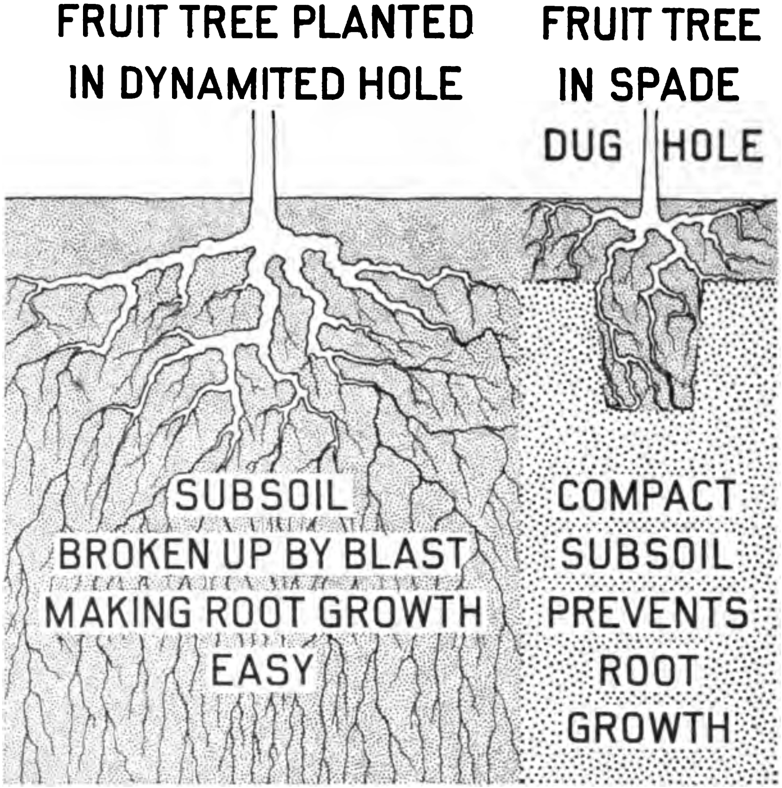

FRUIT TREE PLANTED IN DYNAMITED HOLE
FRUIT TREE IN SPADE DUG HOLE
SUBSOIL BROKEN UP BY BLAST MAKING ROOT GROWTH EASY
COMPACT SUBSOIL PREVENTS ROOT GROWTH

DIAGRAM OF SOIL SECTION AND ROOT GROWTH

Surface Dried by Blasting

This Spring I used in my orchard some of your Repauno Stumping Powder for subsoiling. I notice that after shooting, the surface was considerably drier than before, proving to me it did what I wanted it to do. Also, used the same powder with good success in blasting out some old apple trees.

FRED HAINES,
Zillah, Wash.

P. WELCH. President **R. K. NEIL. Vice-President** **J. T. SULLIVAN. Manager**

Rogue River Valley Canal Company and Roguelands Incorporated

MEDFORD, OREGON.

E. I. du Pont de Nemours & Company, Seattle, Wash.:

Gentlemen:—In compliance with request of your Mr. R. A. Borst, we take pleasure in advising you as to the progress being made by our young orchards.

Since the Spring of 1911 this company has set out about 44,000 fruit trees, mostly pears, all of which have been planted with dynamite. That is, several months before planting, in order to give the ground time to settle properly, we drill to a depth of about three feet through our close gravel subsoil and blow out the hole with a charge of your dynamite. This reduces the hard subsoil to loose gravel for a radius of from five to six feet around the hole and this area gradually increases, due to the action of water and air upon the shattered subsoil. The top soil is also loosened up so that deep plowing is easy from the start. The size of the charge depends upon the thickness and hardness of the subsoil to be blasted.

There is no doubt about the value of shooting in this manner. It supplies the tree roots with practically an unlimited field in which to spread out and down and also forms what may be termed "Soil Sponges," which absorb and retain great quantities of moisture, giving it up to the tree roots as required.

We do not believe that better trees, at their ages, can be found elsewhere in the valley. At least we have not been able to find any. This may sound like "enlargement of the ego," but several proud orchardists have already been convinced that their trees are no better than second to ours.

MR. STOREY'S THREE YEAR OLD APPLE TREES. ALL SET IN BLASTED HOLES

We hand you herewith another photograph taken on one of our tracts on September 20, 1913, showing apple trees planted in March, 1911. This tract is owned by Mr. Hugh Storey. The value of shooting is clearly demonstrated here. These trees are certainly making excellent growth and in addition, Mr. Storey's place has yielded fifty bushels of corn per acre from between the tree rows.

It has been proven in several of our local orchards that shooting has greatly benefited old trees and in our opinion shooting should be resorted to in a great many of the "Sticky Orchards" of the valley. The yields of some of these orchards should be increased at least 25 per cent. by blasting.

It would be well to place some of our orchardists on your mailing lists for publications bearing on this subject.

Yours very truly,
ROGUELANDS INCORPORATED,
J. T. Sullivan, Manager.

ONE OF THE THRIFTY YOUNG PEACH TREES SET IN A BLASTED HOLE. PHOTOGRAPHED ON SEPTEMBER 20 AFTER TREES IN UNBLASTED HOLES HAD SHED THEIR LEAVES

Results Apparent to the Eyes

My experience with Du Pont Stumping Powder for orchard blasting makes me a strong advocate of its use. I have used approximately 400 pounds of your Du Pont Stumping Powder. The results I obtained are entirely satisfactory. The evidence is right before me, that the soil takes the water in better shape than it did before I broke up the tight soil that underlies my orchard, and aside from this the apples are a finer grade than they were before. Also, in my orchard I have planted alfalfa and its growth on the land which has been shot up is considerable in excess of that on which no powder has been used. Adjoining my orchard is one on which no powder has been used. This is planted in alfalfa between the trees, also, and the evidence is before anyone who wishes to look into the matter showing the superiority of land, that has had the tight soil broken with powder over that which has been merely scraped over with a plow. As is well known, a plow, and a deep soil one, at that, will just go so deep. There is no end to the depth that powder will go and which is only determined by the depth of the hole you put in and the charge of powder.

You have my permission to refer anyone to me who may be considering giving powder a try-out for the purposes I used it.

R. H. HOTCHKIN,
Wenatchee, Wash.

Blasting Results in Marked Improvement

I have pleasure in acknowledging your request for account of results after using your Repauno Stumping Powder in my orchard. I think the results well worth the labor and powder expended. Last Fall I used enough powder to break up the hardpan around over 300 trees, and this Fall intend using considerable more. This year I notice a marked improvement in the quality of the apples over that grown last year, and this in my estimation is proof conclusive as to the merit of using powder for breaking up the hardpan, which in places is too deep for a deep soil plow to reach.

Another feature is that the soil takes the water better after shooting.

H. D. JACKY,
Wenatchee, Wash.

Crops Increased by Subsoiling

It gives me pleasure to advise that using Du Pont Stumping Powder for orchard work, has given me good satisfaction. This year is the first I have tried it, with the result that the soil takes water better than in previous years. Also, last year's crop of cherries was a good one, yet after the subsoiling my cherry orchard this year, I got one and one-half tons more of cherries. Generally speaking, the results were fine, and I am satisfied powder will more than pay in orchards where the soil is tight.

H. R. HUMPHREY,
R. D. No. 4, No. Yakima, Wash.

Soil Takes Irrigation After Blasting

The results I secured from using Repauno Stumping Powder in our orchard were satisfactory. The orchard this powder was used in was an old one, and the soil gets parched and does not take the water well. I shot 400 shots approximately, using about one-half cartridge to a shot, and the result is that the soil took the water in good shape, which it would not do before it was subsoiled.

In my opinion powder is the only thing that will break the soil to a proper depth and I feel sure it is economical to use it.

M. CHRISTOPHER,
No. Yakima, Wash.

ONE OF THE EARLY TESTS. A SUCCESSFUL ORCHARD PLANTED WITH DYNAMITE IN JOSEPHINE COUNTY, OREGON, IN 1897

Tight Orchard Soils Mellowed

Your representative has asked me for an expression of my opinion as to the results of your Repauno Stumping Powder for blasting tight soil in my orchard, and I have to advise that it did its work to my satisfaction, and to better explain, I might mention that last year I noticed that in certain spots in my orchard some of the trees did not turn out the crops they should have done. I tried digging around the trees, and found the soil very tight and hard, with the result that I tried out your powder and while just after shooting the soil, it showed no appreciable results, yet this year's crop leaves no doubt but that the powder has increased the yield considerably. You may quote me to anyone who may be considering using it.

R. BAILEY,
Wenatchee, Wash.

CALIFORNIA

MADE $15 LAND WORTH $200

DAVIS CREEK. Planted 14,000 fruit trees with Red Cross, and by its use have advanced the value of land from $15.00 per acre to $200.00 per acre in less than a year.

O. C. LANGFIELD.

REJUVENATED SICKLY TREES

SARATOGA. Planted a block of five trees, in spade-dug holes, that did not grow. Afterwards used Red Cross to rejuvenate them and the trees showed vigorous growth at the end of the first year.

GUY U. SMITH,
State Assemblyman.

DO YOU PREFER SCRUBS?

CARPENTERIA. Used Red Cross in planting 1,000 trees. Trees planted in spade-dug holes look like scrubs beside the ones planted in blasted holes.

CHAS. L. LUNDY.

EXPERIMENT YIELDS PROOF

ORANGE. Used Red Cross in the center of some squares in my orange grove. The experiment confirmed my belief of long standing that many of our groves planted on the heavier soils would be much benefited by the intelligent use of Red Cross.

C. J. K. JONES.

SAVES IRRIGATION

RIVERSIDE. Found blasting saves one to two irrigations per year.

RIVERSIDE CHAMBER OF COMMERCE.

COLORADO

NURSERY HIGHLY RECOMMENDS BLASTING

LOVELAND. Used 2,000 pounds Red Cross in planting 10,000 trees. Results very satisfactory. We highly recommend its use in orchard planting.

THE NORTHERN COLORADO NURSERY CO.,
M. R. Kilburn, Mgr.

FRUIT WON WORLD'S PRIZE

GOODPASTURE. Planted 300 trees with Red Cross at only one-tenth of the cost of setting the same amount of trees in spade-dug holes. Fruit from trees in blasted holes won World's Prize.

LEE R. ROPER.

GAINS A YEAR'S GROWTH

OXFORD. Trees planted with Red Cross have done finely.. Had but little loss and trees are thriftier. Trees in blasted holes have one year's growth over those planted in spade-dug holes.

L. A. O'DONNELL.

STOPS FIRST YEAR LOSS

DENVER. Lost only nine trees out of 728 planted with Red Cross and am convinced an additional advantage is obtained by its use. Would not consider planting any other way.

F. W. GRAHAM.

INCREASED YIELD 60 PER CENT.

GRAND JUNCTION. I had 14 pear trees in my orchard that never produced over 71 boxes or five boxes to the tree. Since using Red Cross in this orchard, the trees have regularly produced 114 boxes or eight boxes to the tree.

CHAS. P. SHEEHAN.

BLASTED TREES 50 PER CENT. BETTER

RIFLE. Trees planted in blasted holes are 50 per cent. better than those in spade-dug holes.

J. L. STEWART.

IDAHO

GROWTH OF TREES MARVELOUS

BOISE. In the Fall of 1912, used Du Pont explosives to break up hardpan and subsoil in my orchard. Trees were planted the following Spring and given the usual cultivation. Gave the orchard a light irrigation the first of July and did not irrigate again that season. Growth of trees marvelous.

T. A. JOHNSON.

EXTRAORDINARILY HEALTHY AND THRIFTY

I know that where I used the dynamite the trees have been extraordinarily healthy and thrifty.

VEATH REALTY COMPANY, LTD.

MONTANA

MADE MUCH BETTER GROWTH

DARBY. Planted 40,000 trees in blasted holes. Trees made a much greater growth than those planted one year before where Red Cross was not used.

W. I. MOODY,
Como Orchard-Land Co.

A GREAT TIME AND LABOR SAVER

HAMILTON. Planted 36,000 apple and cherry trees with Red Cross and found it to be a great time and labor saver.

WALTER E. LONG.

OREGON

COST HALF AS MUCH

PORTLAND. Trees planted in blasted holes show marked improvement over those planted by spade. Blasted holes cost just one-half as much as spade-dug holes.

IRVING WORTHINGTON, C. E.,
Rogue River Valley Canal Co.

MONEY WELL SPENT

GRANTS PASS. Planted 3,000 trees in blasted holes. Found that Red Cross is money well spent in orchard planting on any kind of land.

TOKAY HEIGHTS DEVELOPMENT CO.

MORE AND BETTER FRUIT

MEDFORD. Orchard rejuvenated by blasting between trees yields more and better fruit.

J. H. NEUSTADT,
Owner Liberty Orchards.

BLASTS EVERY TREE HOLE

GRANTS PASS. Thirty acres of new orchard and every tree set with Red Cross. Would not undertake to clear ground or set new trees, shade or orchard, without using it.

MRS. JOHN RAWLEY.

WASHINGTON

ENTIRELY SATISFACTORY

NORTH YAKIMA. Planted 900 trees with Red Cross. Loss about four and one-half per cent. In spade-dug holes loss about 10 to 20 per cent. Results in blasted holes entirely satisfactory.

JAS. W. MATSON.

MARKED BENEFIT

SPOKANE. Used several hundred pounds Red Cross in my orchard, and am convinced that the beneficial effects of this treatment are very marked. The shattering of the subsoil makes available a largely increased amount of fertility.

LOUIS A. DYAR.

ROSETTE CURED

NORTH YAKIMA. Through the use of Red Cross have gotten quick results from two trees badly affected with rosette. Both seem to be entirely cured.

F. H. HUNTER.

MARKED IMPROVEMENT

WENATCHEE. Used Red Cross in blasting orchard. Portion where blasting was done shows marked improvement over the other trees.

H. D. CLARK.

ROSETTE CURED

NORTH YAKIMA. Know from experience that the loss in planting trees with Red Cross is nil compared with the shovel and pick. I have also overcome the apple rosette by regenerating my orchard with Red Cross.

PAUL G. KRUGER.

Underground Effects Upon Roots of Trees Planted With Red Cross

Although Red Cross has been used for blasting holes in which to plant fruit trees as long ago as twenty years, it has only been within the last few years that the practice of blasting holes has become at all general. The method is now known and used in every State in the Union. It is enthusiastically recommended by horticulturists, nurserymen and fruit growers, who have tried it and who have carefully noted results.

Many photographs, showing comparative surface growth and development of trees planted in blasted and spade-dug holes, have been published, but it was only very recently that any photographs could be shown of root development. It is an accepted fact horticulturally that a tree's root system is practically commensurate with its above-ground limb and branch system. It is, therefore, of interest from a scientific standpoint to actually see the growth made by roots which have been assisted to penetrate the feeding bed by blasting the subsoil with Red Cross in comparison with the growth made by a young tree of the same age, in the same type of soil, planted in an adjoining plot in a spade-dug hole.

Figures 1, 2, 3 and 4, shown on the following page, provide such views. Figures 1 and 3, are views of trees planted in blasted holes; figures 2 and 4, of trees planted in spade-dug holes. It will be interesting to note the superior root development of the trees shown in figures 1 and 3. It will also be seen that the branch development of these trees is in proportion to the root growth.

The trees shown in figures 2 and 4, have much smaller root development and, as is to be expected, similarly small above-ground growth.

The reader's attention is specially called to the uniform growth or spread in every direction of the roots shown in figures 1 and 3. The soil, having been thoroughly pulverized and mellowed by the blasting, has enabled the roots of these trees to penetrate their feeding beds easily and evenly in all directions, thus not only securely anchoring the trees and protecting them against damage by high winds, but enabling them to reach plant foods in every direction from their trunks.

Observe the difference in figure 2. Here the roots are shown bunched and extending in one direction only. How much less securely anchored and how much more at the mercy of the winds is a tree with such root development; also how much more restricted is its feeding ground, the plant food in the soil on the sides of the tree not penetrated by its roots all practically going to waste.

The chief objection to starting an orchard is the slow return from the investment. Experience has proved that trees set in blasted ground bear fruit one to two years earlier; the loss from dying trees is practically eliminated, and the benefits of such planting are continuous.

Figure the cost of the trees for an acre of orchard, plus cost of spade planting, plus taxes for the fruitless years, plus 33 per cent. average first year loss of trees, and another year's delay to replace them, plus interest on value of land during the fruitless years. Then figure again using the planting-with-explosives-costs, eliminating the first year losses, and cutting down fruitless years by at least one.

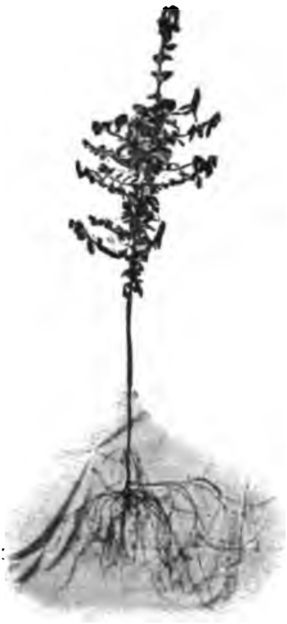


FIG. 1

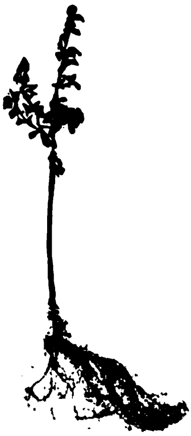


FIG. 2

Trees 1 and 3 were planted in blasted holes.

Trees 2 and 4 were planted in unblasted holes.

All trees are the same age.

Even if the fruit from trees planted in blasted ground were not superior in size, amount and value, the financial advantage apparent from the above calculation should cause every orchardist to adopt the blasting method, except those having a deep soil, mellow to a depth of five to six feet, in which case blasting will be of no benefit, except to destroy fungus, nematode, and similar pests.

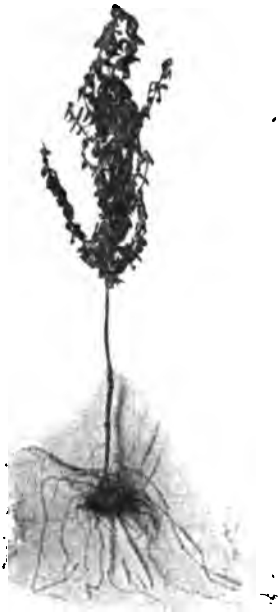


FIG. 3

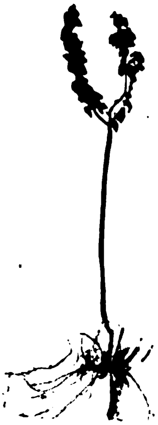


FIG. 4

Blasting Around Growing Trees

You doubtless remember me telling you a few years ago about blasting around some pecan trees with dynamite and how they outgrew the others. I am sending you a photograph of one of these, taken two years ago, when the tree had been set six years, and one year after the blasting. It has since developed quite rapidly and is now more than three times as large as the trees not blasted.

Last year the trees where blasted withstood the drouth and matured *much* larger crops and better filled nuts than did the trees not blasted.

I just drive a crowbar three feet into the ground on three sides of the trees. in a triangular shape, about the ends of the roots and blast them with one-half a cartridge charge any time in the Fall or early Spring when the ground is dry. In land where I grow crops the blasts are placed on only two sides. If this is done in the Fall so that the broken soil can take in the Winter rains, you need not be uneasy about dry Summers and shedding nuts. I have advised blasting for years for setting out trees, and now I am convinced it pays in cultivating them.

J. A. KERNODLE, Camp Hill, Ala.

Table of Charges and Amount of Stumping Powder Required per Acre for Planting Trees

Distance between trees, square method	Trees per acre	Amount of explosives per acre using ½ cart. per tree †	No. 6 Blasting Caps, per acre	*Fuse per acre 2½ ft. per tree
15 ft.	196	58 lbs.	196	490 ft.
20 "	110	32 "	110	275 "
30 "	49	14 "	49	122 "
40 "	25	7 "	25	63 "

* It is necessary to have as many inches of fuse per hole as the hole is deep.
† If a whole cartridge is used double the amounts.

Table of Charges and Amount of Explosives Required per Acre for Orchard Rejuvenation

Distance between trees, square method	Trees per acre	Location of holes for Explosive	Number of holes per acre	Pounds of Stumping Powder per acre using ½ Cartridge per hole *
15 ft.	196	Midway between on diagonal lines	198	58
20 ft.	110	"	110	32
20 ft.	110	Midway between on square lines	210	62
30 ft.	49	"	91	27
30 ft.	49	Ten feet from tree on three sides	147	43
40 ft.	25	"	75	22

* If a whole cartridge is used double the amounts.

Vertical Farming

The origin and character of soils, the nature and sources of plant food, and the necessity of good soil sanitation are fully covered in VERTICAL FARMING, a book prepared by Dr. Gilbert Ellis Bailey, of the University of Southern California, and published by this company.

For satisfactory crop production the soils should be well drained, well aerated or ventilated, and well cultivated to a depth of several feet.

The chief troubles to be overcome in making soils conform to these specifications are hardpan, tight clay and poorly drained subsoils. Such subsoils prevent the downward movement of water into the soil, and permit it to be lost by evaporation, or worse by surface runoff, which causes erosion; exclude the air needed by beneficial bacteria and for the preparation of plant foods; seriously retard or absolutely stop the penetration of roots, and absorb too little water for the maintenance of crops.

Importance of Water Storage

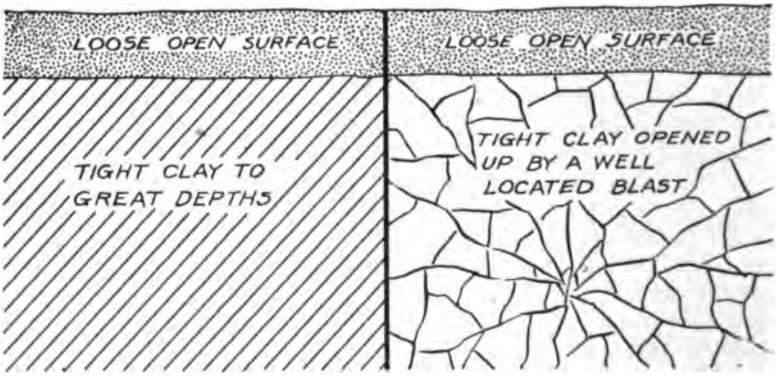
The greatest limiting factor in the production of crops in the United States is the scant supply of soil moisture during the growing season. This is especially true of summer crops. There is a sufficient rainfall annually in most of the general agricultural sections to increase the average yields to much more than double the present figures. The greater part of this is lost either through bad drainage or by surface evaporation and is never used by the plants. The first great care of the grower should be to store every possible drop of the rainfall or irrigating water in a well-tilled subsoil and hold it there indefinitely so that it may be available to nourish the crops to the best advantage when there is by far the greatest demand for water. Instead of laying up money for "a rainy day," it is "storing water for a rainless day."

The position and character of the impervious material in the subsoil governs very largely the extent and character of the damage done by the faulty absorption of moisture. Over a great part of the United

States we find a reasonably good surface soil underlain by a tight impervious clay to great depth. On such a soil the amount of moisture absorbed will be governed almost entirely by the surface, as the underlying material is too tight and close for the water to penetrate quickly to any considerable depth, and so it is lost by evaporation or by running off along the surface. The accompanying sketch illustrates this. The first rain soaks the few inches of surface to saturation, but cannot easily go deeper, and a very unsatisfactory as well as dangerous condition is produced. The good fertile top soil is held practically in suspension awaiting only a heavier rain to carry it off down the slope, leaving only the tight material that was below. Even if the condition does not become so extreme, and there is no loss by erosion, there can be but little absorption and storage of moisture and crops will suffer.

Blasting to Loosen Tight Subsoils

To improve the mechanical condition of such a soil the underlying material should be blasted to loosen it to a depth of not less than three or four feet. In some cases it is better to go deeper. When such a treatment is given, the movement of moisture is at once affected. Instead of being checked at the bottom of the plowed furrow it penetrates immediately into the subsoil where it can spread out at will and where it will be absorbed and later used to supply the needs of the growing crop.


LOOSE OPEN SURFACE
LOOSE OPEN SURFACE
TIGHT CLAY TO GREAT DEPTHS
TIGHT CLAY OPENED UP BY A WELL LOCATED BLAST

FOR DEEP, TIGHT CLAY BLASTING SHOULD BE DEEP AND THOROUGH, AND SHOULD BE DONE WHEN THE CLAY IS DRY

This work should be undertaken towards the close of the dry season, when the subsoils are usually in the very best condition for shattering. It will then absorb the heavy winter rains and snows and hold them for future use. Impervious clay is usually plastic or sticky, and if blasted when wet will not be benefited and may even become more objectionable than before. When dry it shatters and pulverizes well and is converted into a cracked, porous mass that will permit the circulation of both air and water, and the deep downward growth of roots. It is in this cracked condition that it absorbs the maximum amount of water and produces the heaviest crops.

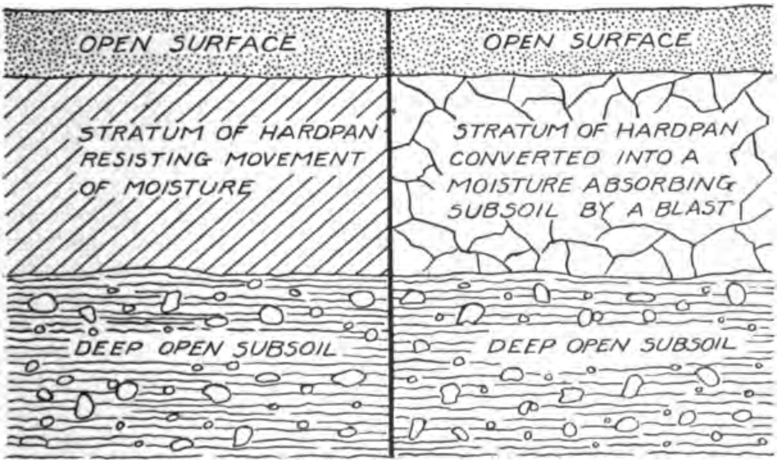
One Blasting Suffices for Several Years

The duration of the benefits thus obtained is not as yet clearly worked out, but it appears from tests that they should be effective for a considerable number of years. So far they have been more marked during the second and third years after blasting than during the first. If proper attention is given to the surface it is quite unlikely that they will return to their former state within the life of man. When heavy, deep-rooted crops such as alfalfa, for instance, are used to supply humus and increase the supply of nitrogen, the deep roots left to decay in the soil will guarantee the permanency of the benefits. *Planting of a deep-rooting crop should always follow subsoiling.*

Hardpan

Another prevalent subsoil trouble is encountered in the layers of hardpan so often found within two or three feet of the surface. These act just as do the tight clays, already described, in preventing the absorption of moisture and are likely to be the cause of serious trouble from erosion, in addition to limiting the crop-producing capacity of the soil.

In blasting such a soil, to get the most benefits, the explosive must be placed in the layer of hardpan without reference to the exact depth of the loading. Sometimes this may be not more than two feet in depth, and again it may be best to go as deep as three or six feet. The effect is to break up the hardpan and permit the moisture to move freely. This increases the amount that may be absorbed and permits the growing of maximum yields. The effect on root development is the same as when the deep clay is blasted.


OPEN SURFACE
STRATUM OF HARDPAN RESISTING MOVEMENT OF MOISTURE
DEEP OPEN SUBSOIL
OPEN SURFACE
STRATUM OF HARDPAN CONVERTED INTO A MOISTURE ABSORBING SUBSOIL BY A BLAST
DEEP OPEN SUBSOIL

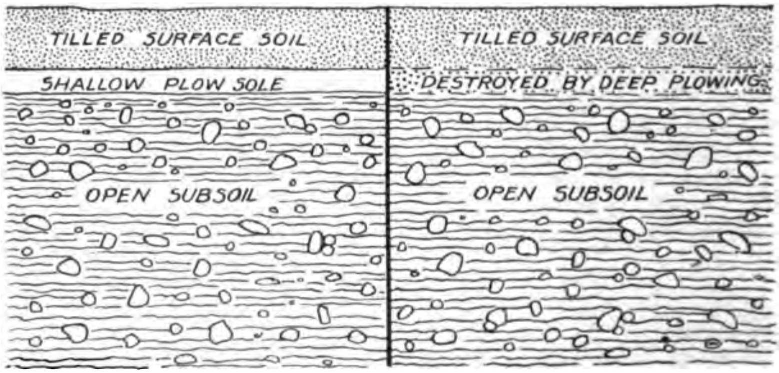
A LAYER OF HARDPAN OVER OPEN MATERIAL IS EASILY DESTROYED BY BLASTING. THE CHARGES SHOULD BE PLACED IN, AND NOT UNDER, THE TIGHT MATERIAL

In such a soil the blasting not only makes soil out of the hardpan, but opens up the way to the underlying good subsoil so that it, too, may assist in nourishing the crop.

Such hardpan is all too frequently found under the alkali surface of irrigated land. When this is the case blasting should be done at once.

Plow Sole

Plow sole may be found either in connection with the other impervious conditions or alone. It lies closer to the surface and may not extend deeper than eight or ten inches. When such a condition is encountered the most satisfactory relief is by thorough and deep surface tillage. If it can be broken up by deep plowing, that is the best way to get after it. When this is not practicable, and the tillage must go deeper, a machine like the Spaulding Deep Tillage Machine offers the best relief, as it will not only break up the plow sole, but will mix it with the better aerated surface soil, and materially hasten the preparation of an ideal cropping soil.



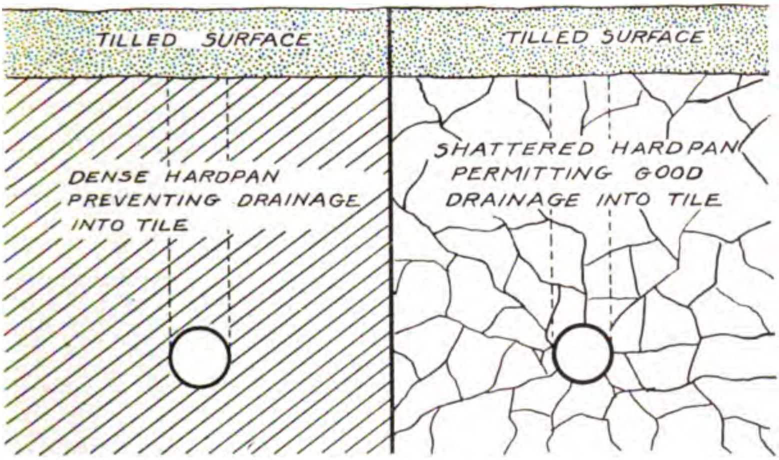
PLOW SOLE OR SHALLOW HARDPAN IS MOST EASILY BROKEN BY PLOWING TO GREATER DEPTHS. THIS MAY BE DONE IN CONNECTION WITH BLASTING FOR PULVERIZING DEEPER HARDPAN

The combination of deep surface tillage and blasting becomes applicable when both shallow hardpan or tough plow sole are encountered in connection with deep hardpan or tight clay. When only one adverse condition is encountered, the treatment selected should be the one applicable to the condition.

Sometimes a soil is found where the surface and upper sub-surface are well tilled to considerable depths and the tight clay is not found except at a considerable depth. Such soils lend themselves readily to subsoil blasting, as the great benefits of the naturally deep soil can be materially increased by creating still more open material to absorb more water and to give better drainage in case of torrential rains. Such blasting must be deeper, and heavier loading may, in some cases, be found advisable.

Blasting to Assist Drainage

Aside from the benefits of explosives for shattering impervious subsoils as above described, this method of soil tillage finds ready application in shattering subsoils to assist other drainage methods that are not giving satisfactory results. Tight clays and hardpan soils where tile drains are found to function poorly and establish drainage courses slowly, if at all, are found to be greatly improved by shattering the subsoils between the lines of tile. The same is found to be true in soils that are but little affected by open drains, where the water is held in too large amounts in the subsoil quite near the drains. Care, however, must be taken not to blast nearer than seven or eight feet to a tile drain.


TILLED SURFACE
DENSE HARDPAN PREVENTING DRAINAGE INTO TILE
TILLED SURFACE
SHATTERED HARDPAN PERMITTING GOOD DRAINAGE INTO TILE

OFTEN HARDPAN PREVENTS THE DRAINAGE WATER FROM PASSING INTO TILE OR OPEN DRAINS. THE RELIEF IS THROUGH BLASTING, WHICH OPENS UP THE NEEDED DRAINAGE COURSES

This is also most highly recommended for the relief of alkali soils, especially on those where the hardpan materially interferes with the action of the drains.

Soil Makers

The reason why deep tillage or subsoil plowing is desirable is that all the soil below the bottom of the ordinary plow cut, in other words, everything below six to eight inches, is still in its primeval condition. It has never been disturbed. Chemical analyses of soils down to a depth of twenty feet show that on the average acre there are tons of plant foods which become available only when roots can penetrate to them, or when ascending moisture brings them up to the roots that cannot get down.

Alfalfa and other deep-rooted plants are called "soil makers" because they penetrate this compact soil, introduce humus and provide a passageway for the descent and ascent of water which carries with it the soluble, fertilizing elements, but many subsoils are so hard that it is practically impossible for any plant to penetrate them. Even when this is possible there is no use in putting such a burden on the plant, because whatever vitality is expended in making its own home beneath the surface is subtracted from the vitality of the plant above the surface. In other words, the plant that has to fight for its life beneath the soil has little energy left for fruition.

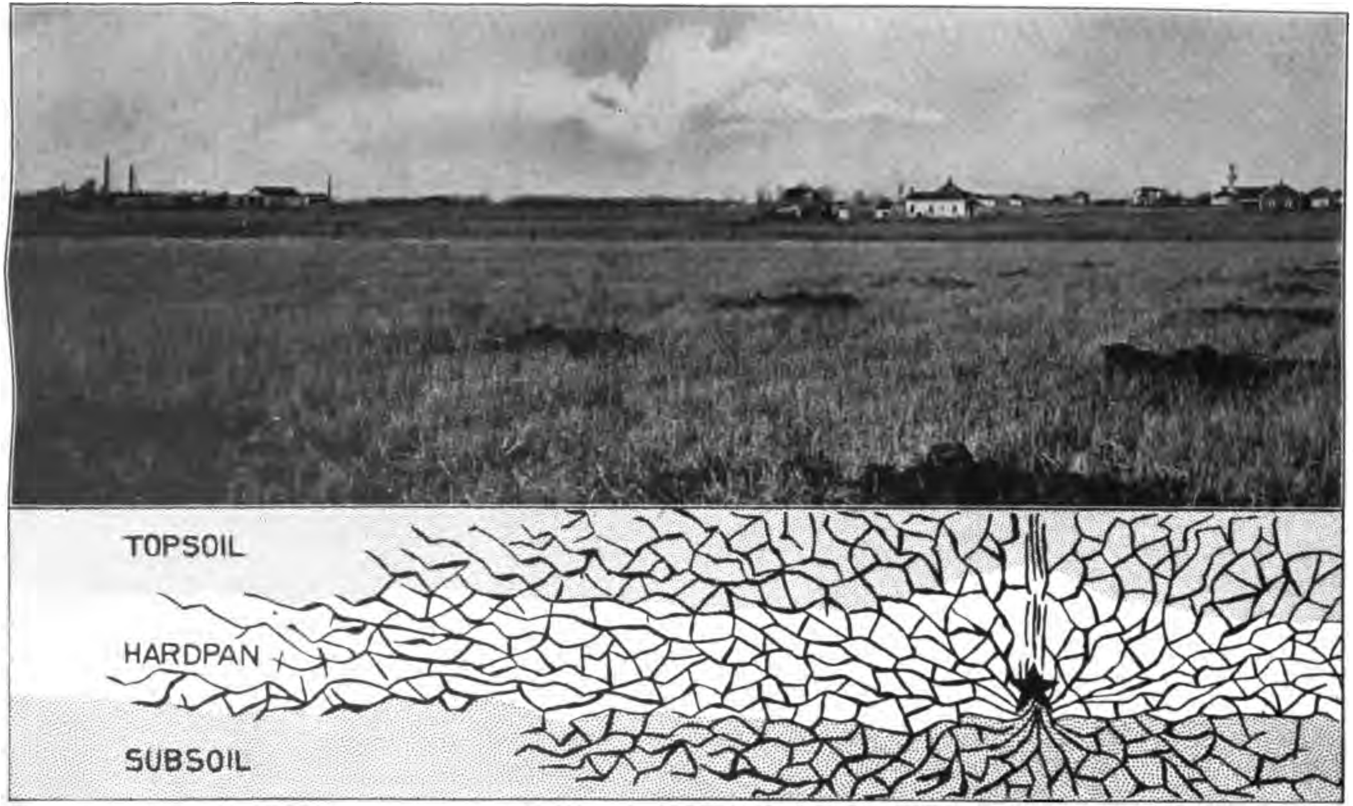
A Better Home for the Roots

If we make root growth easy and quick by breaking up the subsoil, then we make the fertilizing elements of the subsoil immediately available and save the energy of the plant for fruition. We also create in the subsoil a porous condition favorable to the storage of water at a depth that will not keep the soil cold, and yet near enough to the roots to feed them through capillary attraction. Subsoiling also introduces air into the soil, and it is just as necessary for the roots of a plant to have air as it is for a human being to breathe.

The effect of subsoiling virtually is to change a farm from a six-inch layer of topsoil to a six-foot layer.

RESULTS IN A GARDEN

This cut shows a plot of garden beets, the ones to the right planted on ground subsoiled with Red Cross ten days after those on the left were planted on ground not subsoiled. The beets on blasted soil matured very early and brought 75 cents per dozen bunches, the others were much later and brought only 40 cents per dozen bunches.



HARDPAN BLASTED WITH RED CROSS. WITH SECTIONAL VIEW OF SOIL

EX-GOVERNOR STUBBS, CONGRESSMAN CAMPBELL AND GENERAL PORTER WATCHING SUBSOILING DEMONSTRATION IN KANSAS

A pioneer in subsoiling with Red Cross was General Samuel J. Crawford, ex-Governor of Kansas. Below is a letter from him that tells of his experience:

"I am glad the good work of blasting the compact subsoil and hardpan is moving along in the east as well as in the west, whether it be for the planting of trees, grain or anything else that grows from the ground. If the subsoil is loosened so that the rainfall can penetrate the earth, the roots of grain, grasses, trees, etc., will follow the water to their natural depth and draw their nourishment from five or six feet of soil instead of five or six inches of surface soil, as heretofore. Besides, the blasting creates sub-reservoirs in which to store the surplus rainfall which will supply the roots of the growing products with moisture, when the dry season is on. Again, if the ground is loosened so the water can pass down into sub-reservoirs, there will be no standing water on the surface to damage the crops or keep the farmers back with their work. Such treatment, properly applied, will revolutionize the agricultural and horticultural industries throughout the country.

"The government is spending millions of money for irrigation purposes in isolated places, which, from the nature of things can only benefit a few people, while the blasting process will benefit all the farmers and fruit growers at comparatively a nominal expense. By this process most of the worn-out farms in New England and throughout the country can be reclaimed and made to produce good crops. All that is necessary is for the producers to grasp the idea and learn how to handle explosives."

Milo on subsoiled ground much better than on unsubsoiled. This is an exceedingly good season when the difference was not so marked as it would be in unfavorable seasons.

J. E. MUNDELL,
Bureau of Plant Industry, Dept. of Agriculture, Tucumcari, N. Mex.

Used Red Cross explosives for subsoiling to correct drainage. Before shooting could not be planted to any crop; now any Montana crop will grow on it.

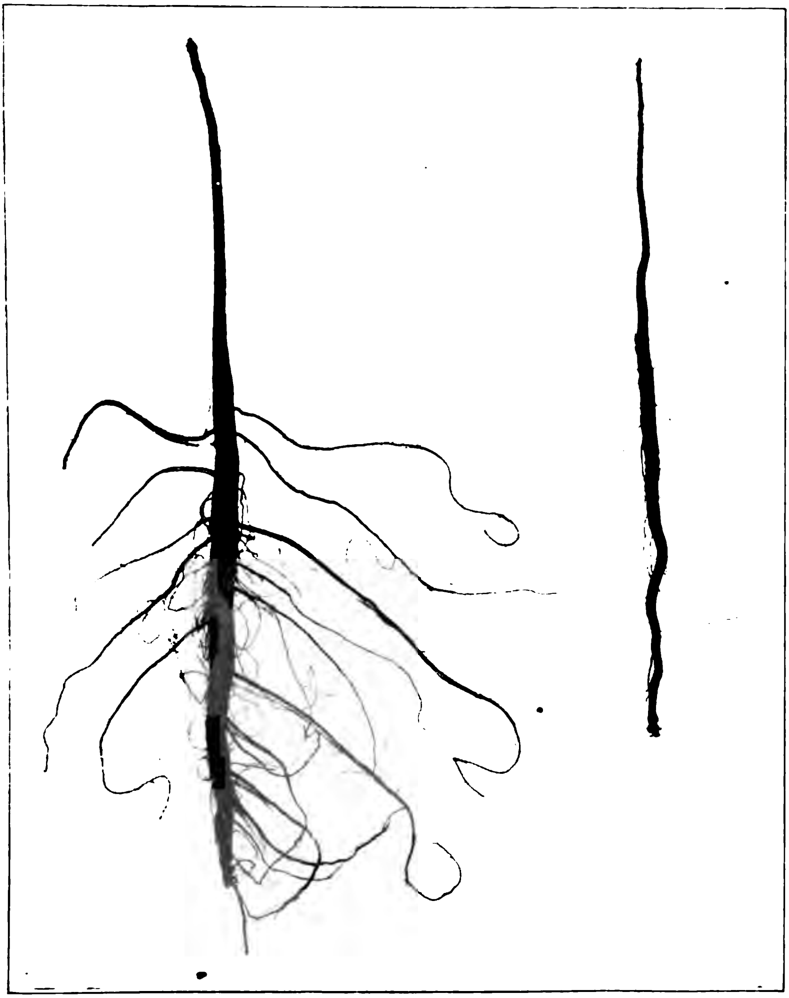
BILLINGS GREENHOUSE CO.,
Billings, Mont.

Used Red Cross explosives for subsoiling to correct drainage in 35-acre field; materials cost $47. Put field in productive state and increased value of the land.

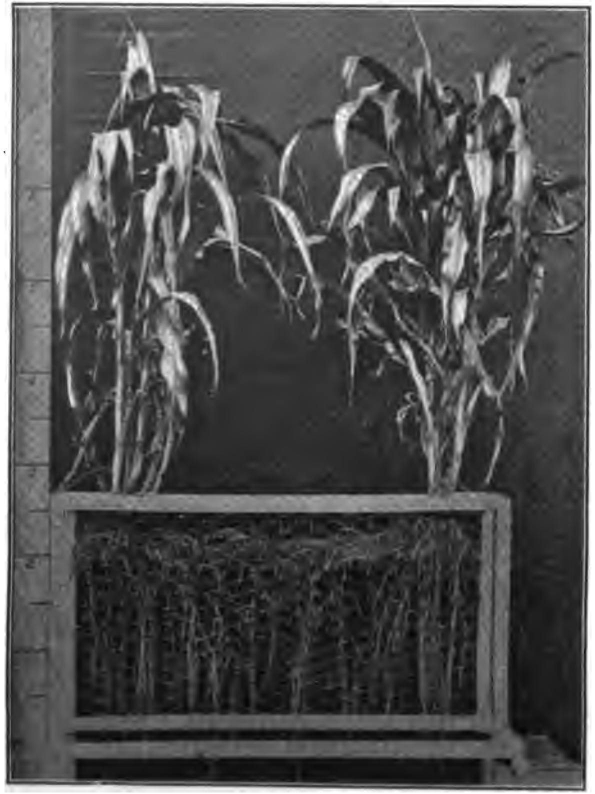
W. J. SNODDY,
Billings, Mont.

Subsoiled area produced more than twice as much corn as the ground on either side.

INT. NURSERY CO.,
Denver, Col.



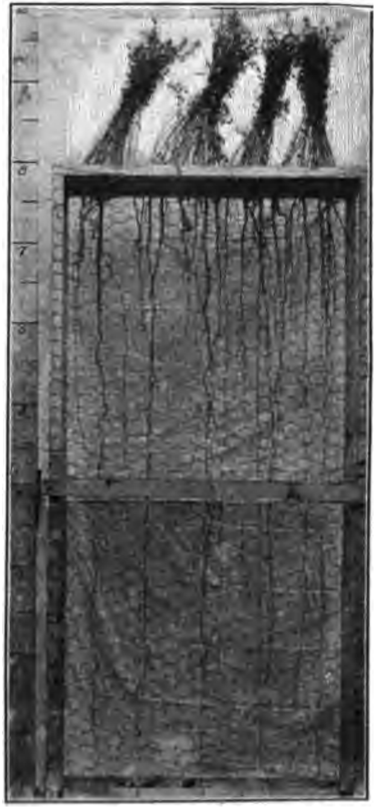
ROOTS FROM BLASTED AND UNBLASTED SOIL



If it costs the value of twenty bushels of corn to raise and market an acre of corn, you are doubling your profits by increasing the yield from 25 bushels to 30 bushels or from 40 bushels to 60 bushels.

SHOWING HOW CORN AND ALFALFA ROOTS GO DOWN INTO SUBSOIL

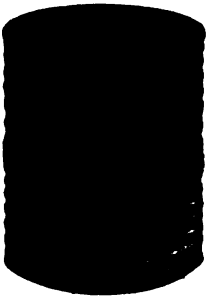
Photos made by Prof. Ten Eyck, Kansas Experiment Station



Explosives for Farm Use

Explosives are solids or liquids which can be changed instantaneously by a spark, great heat or powerful shock into gases having many times the volume of the explosive in its original form. Coal and wood are changed slowly into large volumes of gas by burning; water is changed into a large volume of gas (steam) by heating. This is the whole theory of explosives; and much in their use, which would otherwise seem difficult to explain, is easily understood if this be borne in mind.

Blasting explosives are divided into two classes: "High Explosives" and "Low Explosives." High Explosives, more commonly known as "dynamite," include all of the explosives which can be properly detonated only by means of an intermediate agent such as a blasting cap or electric blasting cap and not by simple ignition. Blasting powders are classified as low explosives and are exploded by a spark.



KEG OF BLASTING POWDER

Blasting Powder

Blasting Powder is produced in granulations or grains of various sizes. It is packed in bulk in steel kegs containing twenty-five pounds. Although it is invaluable for many kinds of coal mine, quarry and general excavating, it is not generally applicable to any blasting about the farm except for splitting logs for timber or rails.

High Explosives

High explosives differ from blasting powder in that they are more powerful, detonate with much greater rapidity, and have a greater shattering effect. The most important properties which contribute to their effectiveness are *strength or disruptive power* and *quickness or shattering power*. Other factors in their usefulness are stability or keeping qualities and such qualities as may tend to make it safer to handle. These essentials can only be secured and maintained by the use of the highest quality of ingredients, greatest care and attention, expensive and complicated machinery, skillful labor and supervision, long experience, and continued tests. The Du Pont Company fulfills all of these requirements. It has been engaged in the manufacture of explosives since 1802 and has factories in many parts of the United States. No other manufacturing concern in this country maintains a greater number of technical chemists than are engaged at the Du Pont laboratories to test daily the output of the factories to prevent deviation from standards, and to study and experiment with explosives in order to improve them.

A corps of experts in the use of explosives is maintained, not only to study the exact requirements of explosives in the various fields and differing conditions, but to demonstrate their qualities, action and use.

In line with our established policy to promoting safety in the use of our explosives, we print the word "DANGER" prominently on every cartridge of dynamite made by us.

In doing this our aim is to protect all as far as possible and particularly those not familiar with the appearance of a dynamite cartridge nor the precaution to be observed in handling it.

Such marking does not mean that our dynamites are any more dangerous than heretofore or more than explosives not so marked.

The millions of pounds of our dynamites used without accident testify to our constant effort to increase their safety.

Such marking, we feel, will promote careful handling because it will indicate to the general public as well as the regular user that there is an element of danger in handling cartridges of explosives carelessly.

Responsible people can use and handle dynamite just as safely as they can handle gasoline, matches or coal oil. The energy of dynamite can be directed in the work to which it is adapted as well as the energy of steam can be directed in the work for which it is used.

CASE OF DYNAMITE

Dynamite is a solid closely resembling fine, slightly greasy sawdust, and derives its explosive power from different compounds of nitrogen. It is packed in cartridges of heavy paper, which is lightly coated with paraffin. The standard size of cartridges is 1¼ x 8 inches, each cartridge weighing approximately a half pound. Shipment is made in tight wooden cases which contain either twenty-five or fifty pounds (net) of dynamite. Where possible, users should always buy by the case, as a better price can be obtained.

Shipments are made in 25, 50, 75, 100, or other multiples of 25, pound lots.

Kinds of High Explosives

There are many different kinds of high explosives adapted to uses in mines and elsewhere, but for agricultural work Du Pont Stumping Powder, Repauno Stumping Powder, the different strengths of Red Cross Extra Dynamite, Du Pont Straight Dynamite and Red Cross Gelatin are recommended for the different purposes described in this book.

Du Pont Stumping Powder and Repauno Stumping Powder

are low-freezing explosives, especially adapted for electric ditch blasting, for blasting large Western stumps, shattering hardpan, planting trees, and loosening tight soil.

Red Cross Extra Dynamites

are low-freezing explosives, especially adapted for electric ditch blasting, boulder blasting, pond drainage, ice blasting, tree planting, road grading, and post hole digging. They are, in short, general all-around explosives that can be used for many classes of work. They are manufactured in strengths ranging from 20 per cent. to 60 per cent.

Du Pont Straight 50 Per Cent. Dynamite

is quicker and more shattering in its action than are the Red Cross brands. Its special adaptation is for blasting ditches in wet soils by the propagated method (that is, without blasting machine), for mudcapping hard boulders where there is a lot of the work to do, and for digging deep post holes. It is more sensitive to shock than are the Red Cross brands, and requires more careful handling. It should be detonated with nothing weaker than a No. 6 detonator. It is not low freezing. When frozen it should be thawed only as recommended in the section on thawing. The freezing point cannot be definitely given, but is between 45 and 50 degrees F. The straight dynamites are all manufactured on the proven Du Pont formulæ and can always be depended on to develop their full strength and efficiency, and resist water well, so that they can be used in wet work.

Red Cross Gelatin

closely resembles dynamite in general appearance, but is more plastic. It is also low-freezing, and resists water better than either Du Pont Stumping Powder, Repauno Stumping Powder, or Red Cross Extra Dynamite. It is manufactured in strengths ranging from 35 per cent. to 75 per cent. The 40 per cent. strength is well adapted to blasting ditches in sandy or loose material and to work requiring that the charges be under water for a long time. This explosive is so insensitive that nothing weaker than a No. 6 cap should be used for detonating it.

Select the Right Grade

In several cases it will be noted in the above that two or more explosives are recommended for the same class of work. This arises from the fact that practically all grades of Du Pont explosives are very elastic in their adaptations and can be relied on for different classes of work. In selecting for a particular class of work use the explosive especially recommended, but where ordering small amounts for a number of purposes, get the one best adapted to them all, when possible.

Prompt Removal from Freight Station

The law requires prompt removal of explosives, including blasting supplies, from freight stations. Hence farmers expecting shipments should arrange with the freight agent or station master to notify them immediately on arrival of shipment, which should be removed within 24 hours.

Hauling

When transporting explosives by team always keep the wagon boxes thoroughly swept out, and when using an open wagon protect the load from sparks and rain with a robe or canvas cover. Lay the cases of explosives flat and so that they *will not shift, and never haul detonators and explosives together.*

Dynamite and detonators should not be hauled together from the dealer's or the railroad station. The detonators do not weigh much, and can be brought along on some other trip. If blasting caps are purchased from a dealer in the tin boxes separate from the wooden shipping case, it is a good plan to put these boxes in a basket or wooden box with a horse blanket, coat, hay or anything else that would keep them from being roughly jarred and shaken on the way home.

Handling and Storing

As soon as explosives are received they should be stored in a dry, properly ventilated building, safe from fire and flying bullets, and far enough away from dwellings or roads to prevent loss of life should they be accidently exploded. They should be kept under lock and key and where children or irresponsible persons cannot get at them. If large quantities are to be stored for some time, a dry, well-ventilated, fire-proof and bullet-proof magazine, located in an out of the way place should be provided. Fuse, wire, thawing kettles and blasting machines may be stored in the same building with the dynamite, but blasting caps and electric blasting caps *must never be stored* in the same building, because they are more easily exploded than dynamite. It would be possible to explode them accidently by a hard shock or jar which would not explode dynamite. If detonators were to explode by themselves, they would not be likely to do much damage unless there were a great many of them, but if they were to explode in the same room with dynamite, they would probably cause the dynamite to explode.

Opening Cases

When ready to use the dynamite, open the box or case with a hardwood wedge and a mallet, and take to the work, in a dry box or basket, the number of cartridges required immediately. Never take more than the day's supply even in warm weather, and in cold weather, take only as much as can be kept thawed until it is to be used, unless there are arrangements for keeping it thawed where the blasting is to be done.

Avoid Confusion

As soon as holes are ready for the dynamite—and when possible the holes should all be ready before the dynamite is brought to the work—the priming, charging, tamping and firing should be carried on as rapidly as possible without becoming careless.

A very little practice will put you in the way of doing blasting quickly, systematically and economically, and you will wonder how you ever got along without dynamite.

Thawing

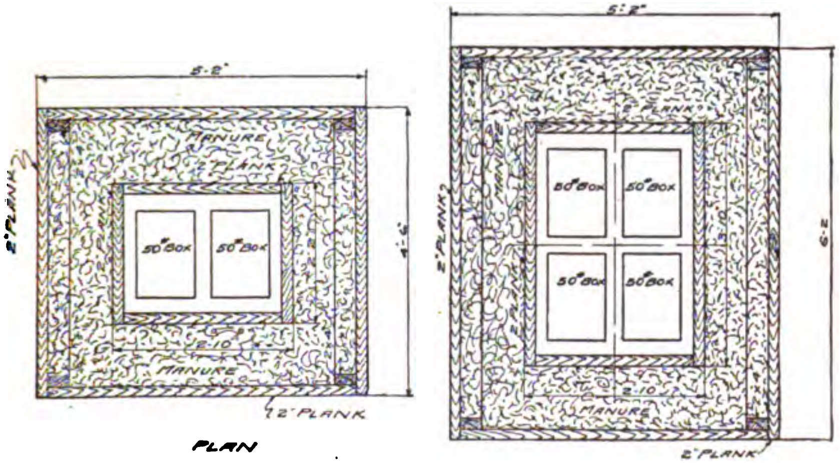
Some kinds of high explosives freeze at about 50 degrees Fahrenheit and detonate imperfectly, if at all, when in this condition. Even when chilled they cannot be depended on to work well. The different low freezing explosives described are exceptions to this rule, for they will not freeze until the weather is quite cold. Frozen dynamite is easily recognized because it is hard and rigid.

DU PONT THAWING KETTLE

If, after the thawed dynamite is ready to use, something causes a delay and it becomes chilled or frozen before it can be put into the borehole, it should be thawed or warmed again. It does not harm dynamite to thaw it many times, provided this is done in the right way.

Red Cross, if loaded in the ground below the frost line and properly tamped, will not freeze again, but other dynamite may chill or freeze almost immediately when loaded in cold ground, which makes it necessary to detonate it immediately after charging. It is this that makes Red Cross so valuable in cold weather.

The best way to thaw dynamite, and to keep it thawed until it is to be used, is in a thawing kettle made for the purpose. It may be thawed by leaving it spread out on a shelf in a warm room (not in a dwelling) over night, or by burying it, while in the case, in green manure. It may also be thawed by putting it in a covered, water-tight pail and hanging this pail in warm water and it may be carried to the work in a dry box if covered with an old coat, a piece of blanket or something of the kind to keep it warm. It is exceedingly dangerous to try to thaw dynamite in front of an open fire, or in hot sand, or ashes, or on hot stones, or metal or steam pipes, or in an oven, and it is in attempting to thaw dynamite in some of these ways that accidents frequently happen. Do not attempt to thaw dynamite by putting the cartridges in hot water or by turning a jet of steam on it.



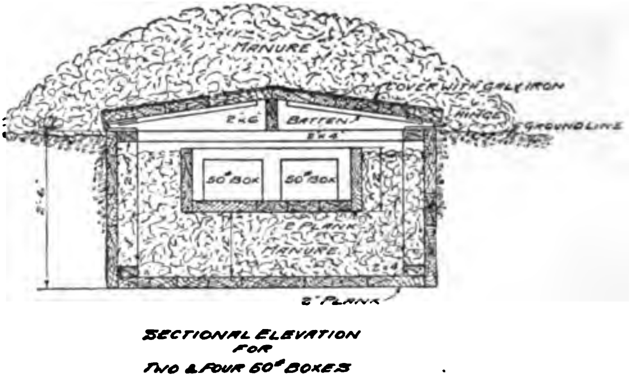
PLAN FOR TWO 50# BOXES

PLAN FOR FOUR 50# BOXES

PLAN OF A PERMANENT MANURE THAWING BOX.

The Du Pont Thawing Kettle is made in one piece with an outside jacket for the hot water. The No. 1 size holds 30 pounds of dynamite and No. 2 size 60 pounds.

The water must never be heated in the kettle, but must be heated in some other vessel, and when not too hot to burn the hand, poured into the water compartment when the dynamite compartment is empty.



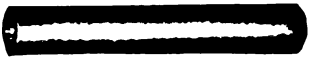
A PERMANENT MANURE THAWING BOX FOR DYNAMITE CAN BE EASILY BUILT ACCORDING TO THESE PLANS

It is dangerous to heat the water in the Du Pont Kettle even when the dynamite section is empty, because there may be a little nitroglycerin in it which has soaked out of the dynamite previously thawed. Dynamite should not be put into the thawing kettles without first carefully wiping out the dynamite compartment clean and dry.

Do not place a thawing kettle over a fire while it contains dynamite.

Blasting Caps

Blasting Caps are the big brothers of the primers in a gun shell—many times bigger. The No. 6 cap, which is the size recommended for detonating most high explosives, is a copper cylinder 1¼ inches long and a little less than ¼ inch in diameter, closed at one end and loaded with 1 gram of a fulminating mixture. The No. 8 size is longer and contains a heavier charge. Nothing smaller than a No. 6 should ever be used with any of the explosives used on the farm because they:



A BLASTING CAP

Insure complete detonation.
Increase the execution of the explosive.
Offset to some extent deterioration, due to improper storage.
Prevent the loss of the charge by burning.

Blasting caps are put up in tin boxes containing 100 caps. From 5 to 50 boxes are packed for shipment in wooden cases. They may be exploded by shock, heat or sparks, so must be kept away from fire. They are weakened by moisture and therefore must be stored in a dry, cool place.

Caps are used only in connection with safety fuse, to which they must be securely fastened. This should be well done with an approved Du Pont Cap Crimper described on this page.

CAP AND FUSE

Fuse

Safety Fuse is a thin chain of powder, wrapped in a covering of jute or cotton yarn or in tape. Its purpose is to bring the spark to a cap used for detonating a charge of high explosives. Many grades are made for different purposes. The ones most used for farm work are Blue Label for dry or moist work, and Bear and Comet for wet work.

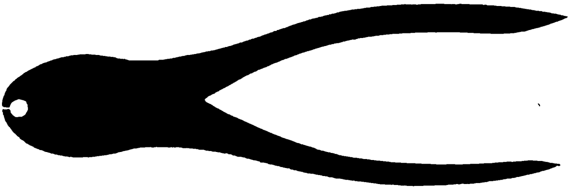
ROLL OF SAFETY FUSE

Fuse is packed in a double roll, one fitting inside the other, each 50 feet long. Each double roll of 100 feet is wrapped separately. It is packed for shipment in wooden cases containing from 500 to 6,000 feet.

Fuse should always be kept dry and should be stored in a cool, dry place. If stored in a damp place it becomes damaged after a time and may fail to burn. If stored in a hot, poorly ventilated place, as for example, close under the roof of a small shed in summer time, it may be damaged either by becoming soft and oily or by drying out and becoming so hard and brittle that it will break when unrolled. Fuse also may become stiff and brittle in cold weather, and when in this condition should be warmed before being unrolled.

Cap Crimpers

Du Pont Cap Crimpers are made especially for fastening caps to fuse and are necessary wherever blasting is done with cap and fuse.



DU PONT CAP CRIMPER

Caps are often crimped by other means, which are dangerous and unsatisfactory. The crimper now sold by this Company is the result of years of experimentation, and is the best ever offered the public.

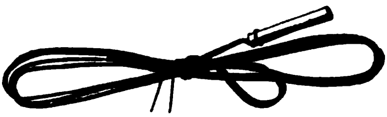
Du Pont Electric Blasting Caps

These, like the cap and fuse, are for detonating charges of high explosives. The explosive charge is contained in a copper cylinder quite similar to the ordinary blasting cap, but the explosion is caused by an electric spark brought along a pair of small copper wires instead of a powder spark from fuse. In strength they are the same as the ordinary caps of the same number. The No. 6 strength is the one adapted to farm work.

It is only by the use of electric caps that a number of charges can be fired at the same time, so they must be used in ditching in dry ground, in blasting large stumps and boulders, or any other work requiring a number of simultaneous explosions.

BOX OF DU PONT ELECTRIC BLASTING CAPS

Du Pont Electric Blasting Caps, like blasting caps, can be exploded by shock or heat, and therefore must be handled in exactly the same way. The same precautions regarding storage and handling as given for blasting caps should be strictly observed. Never attempt to pull the wires out of their setting or investigate the contents of Du Pont Electric Blasting Caps.



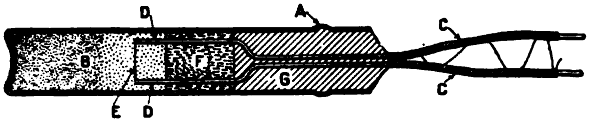
A DU PONT ELECTRIC BLASTING CAP SHOWING WIRES

Besides the advantageous properties of the No. 6 Blasting Caps, as enumerated, No. 6 Du Pont Electric Blasting Caps reduce the chances of misfires, save time, eliminate delayed or premature explosions and in a good many instances save dynamite.

The wires attached to the caps range in length from four feet to thirty feet, but it is seldom that anything longer than a four or six-foot length will be needed in farm work.

These lengths are packed in lots of fifty in strong paper cartons. Ten cartons are packed in a wooden shipping case.

Electric Blasting Caps should be handled with the same care as Blasting Caps.

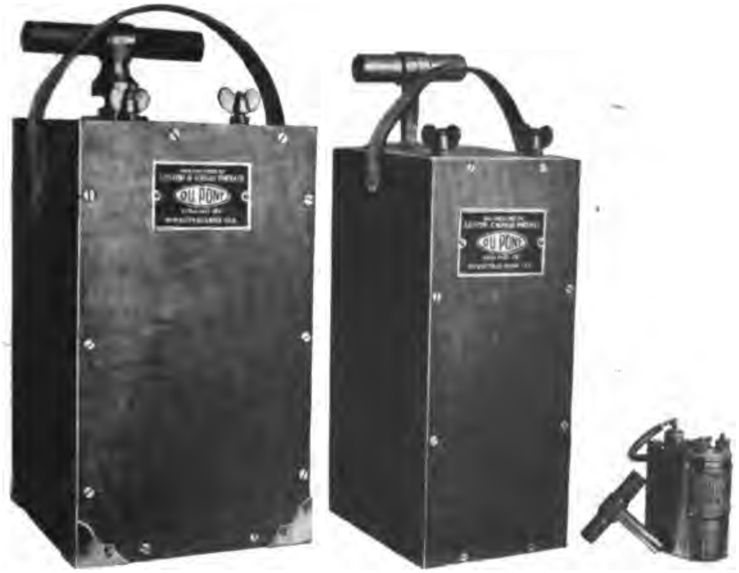


ELECTRIC BLASTING CAP (CROSS SECTION)

"A" is the shell of copper, having a corrugation thrown out from the inside, which holds the filling material more firmly in place; "B" is the chamber containing the explosive charge; "C" the insulated copper wires entering the cap; "D" the bare ends of the copper wires projecting through the plug into the charge; "E" the small platinum wire or "bridge" soldered to and connecting the two ends of the copper wires which is heated by the electric current; "F" the composition plug holding the wires firmly in place; "G" the filling material.

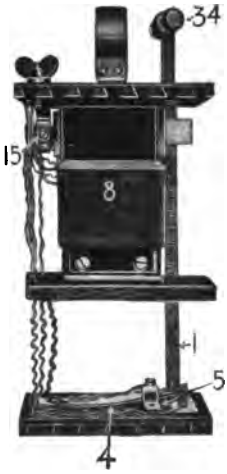
Du Pont Blasting Machines

Du Pont Blasting Machines are small, portable electric generators built for generating current to fire electric blasting caps. The mechanism is operated by a rack bar or plunger protruding through the top of the machine. When operating this bar is pulled up as far as possible, and then forced down with a quick, hard thrust. This sets in motion the armature and builds up the current until the bottom is



No. 6 No. 3 Pocket

RELATIVE SIZES OF DU PONT BLASTING MACHINES reached, when the connections are automatically completed and the current flows out through the leading wires to the electric blasting caps placed in the charges of explosives.



WORKING PARTS OF A BLASTING MACHINE

In practical operation the machine should be placed on a firm or solid place to prevent both machine and operator tipping over.

The current is conducted from the machine to the blast by copper wires attached to the two wing-nut binding posts on the machine. While the machines are built for rough use and every precaution is taken to make all parts strong, they are likely to be damaged by exposure to the weather, and should be wiped off and put in a dry place when no longer in demand.

Blasting machines should be tested occasionally with a Du Pont Rheostat, to be sure that they are working up to standard capacity. A full description of the Rheostat and its use will be sent on application.

Du Pont Blasting Machines are built in five sizes so that a selection can be made to suit the demands of all classes of work.

Sizes and Capacities of Du Pont Blasting Machines

Size of Machine	Capacity—Number of Electric Blasting Caps Copper Wires	Used For
Pocket	1 to 5	Stumping and boulder blasting.
No. 2	1 " 10	Stumping, boulder blasting, and small ditch jobs.
" 3	1 " 30	All classes of general work.
" 5	1 " 100	Large ditches.
" 6	1 " 150	Large ditches.

For stumping, boulder blasting, loosening soils to assist digging and similar work the No. 2 machine will be found entirely satisfactory. Larger blasts having an increased number of charges will require a larger size, but those larger than No. 3 are seldom needed except on large contracting jobs. Even very long ditches can be blasted in sections with the No. 3 machine.

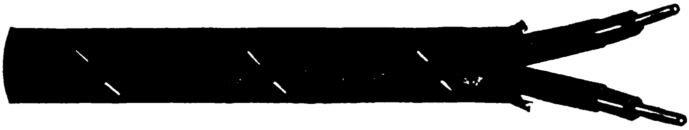
Use of the Galvanometer

The Du Pont Company manufactures an instrument for testing blasting circuits, called the Du Pont Galvanometer. This is a very ingenious and useful instrument, and saves much time in locating breaks in electric circuits. For instructions as to its use ask for our Galvanometer Booklet.

Leading Wire

Leading wire is insulated copper wire for conducting the current from the blasting machine to the blast. The Du Pont leading wire has a strong insulation especially suited to the rough usage it must receive. It is sold in coils of 200 feet, 250 feet, 300 feet and 500 feet. There are two kinds, Single and Duplex. In the Duplex Wire, the two wires are bound together. Single Leading Wire weighs about two pounds to the hundred feet, and Duplex Leading Wire weighs four pounds to the hundred feet. Leading Wire is sold by the pound. The double wire will be found most satisfactory for stumping and boulder blasting and the single wire for ditching.

DU PONT LEADING WIRE



DUPLEX LEADING WIRE (ACTUAL SIZE)

DU PONT CONNECTING WIRE

Du Pont Connecting Wire

Connecting wire is used to complete the circuit when the holes or charges are placed too far apart for the electric blasting cap wires to reach. It is sold in one and two-pound spools. A one-pound spool of No. 20 wire holds about 210 feet.

SHOWING HOW BLAST BRINGS OUT ROOTS

Tools Used in Agricultural Blasting

The tools needed for agricultural blasting are very few and simple. They are often to be found on the farm, but if not they can be quickly made at little cost by a blacksmith. An elaborate outfit is seldom needed even on the large jobs.

Tamping Stick

The tamping stick is used to try out the holes before loading to see that they are properly placed and to a sufficient depth, and not stopped up, and to tamp soil on top of the charges. It must be of wood, with no metal parts. Its length should be a little greater than the depth of the holes to be loaded, and its diameter not smaller than that of a cartridge of dynamite, 1¼ inches.

HOME-MADE TAMPING STICK

An excellent one can be made of an old hoe, rake or shovel handle, or when a very long one is needed, from a sapling.

Subsoil Punch

For driving holes for subsoil blasting, tree planting, for ditching in hard soil, and for road grading, a subsoil punch will be needed. This should be of 1½-inch round or octagonal steel, and a few inches longer than the depth of the holes. The point should be drawn out in the shape of a rather blunt pencil point. This is driven into the ground by means of heavy hammers or sledges.

STEEL SUBSOIL BAR

Soil Auger

The soil auger is used for making holes for stump and boulder blasting, for deep drainage, and for other holes hard to make with a punch. While it can be used for subsoiling it is not as fast as the subsoil punch. It should be 1½ or 2 inches in diameter.

The bit may be welded to a solid steel shank that will make the auger at least five feet long, if for stump or boulder blasting. For deeper work the shank can be made of ⅜- or ½-inch gas pipe in sections of 2 or 3 feet long, so that it can be extended by adding more sections. The handle is made of a pipe "Tee" and two short pieces of pipe for handles.

A good type of auger head can be easily made by a smith. The shank is flattened out and welded into a cuff socket. The handle proper should be of wood and only long enough to make turning easy.

Worn-out wood augers make fairly good soil augers for small jobs, but where there is much work to do it will pay to get the special soil augers shown below.

SOIL AUGER BIT

Wood Augers

Wood augers are used by the blaster for boring into the tap roots of fat pine stumps, and for log and stump splitting. They should be both heavy and sharp. The shank for stump blasting should not be less than five feet long.

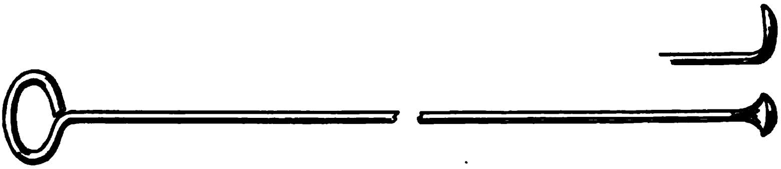
Crowbar

A crowbar will be found convenient for making holes under stumps and boulders, for ditch blasting, and occasionally for subsoiling or tree planting. A crowbar for stump blasting should have a sharp end to cut through small roots.

A satisfactory crowbar for this work can be made out of an old buggy axle by cutting off one spindle and forging a wedge or chisel point.

Spoon

A blasting spoon made by flattening and cupping the end of a ¼-inch steel rod, as shown in the accompanying cut, is very convenient for enlarging bore holes, removing pebbles from holes, and for removing tamping from misfired holes.



A GOOD TYPE OF SPOON

Shovel for Blasting Big Stumps

For digging the holes for blasting stumps described on Page 12 a special shovel is needed. A good type is shown in the following cut. It can easily be made from a tiling spade. A long handle is needed.

Other Tools

Heavy hammers are needed to drive the subsoil punch, and a mattock and shovel can be used for a number of purposes. For block holing rock, a hand drill and hand hammer will be needed.

SPOON SHOVEL WITH LONG HANDLE MADE FROM A TILING SPADE

A long-handled spoon shovel is highly satisfactory for cleaning out blasted pole and post holes and for making the trench under large stumps for heavy loading.

SPOON SHOVEL. USEFUL FOR CLEANING OUT POST AND POLE HOLES AFTER BLASTING

Principles of Blasting

When dynamite or other high explosives detonate—the small volume of solid is converted immediately into a volume of gas many times greater than the solid. If the explosive is unconfined the expanding gases will waste themselves in the air, but if it is confined there is a great pressure exerted on the holding material, which if not too strong, will be shattered or blown away.

The force of the gases is equal in all directions. If the desire is to blow a boulder or stump into the air the charge is placed below the object. The best shattering is obtained if the explosive is placed in the material to be broken so that the force is exerted on it equally in all directions. This is applicable in blasting soils and blockholing boulders or in splitting stumps.

While the gases exert an equal pressure in all directions they try to escape by the easiest route or along the line of greatest weakness. If the tamping is omitted or is insufficient the tendency will be to blow out through the bore hole. If a hole is placed to the side of a stump the tendency will be to blow out through the more easily lifted soil. The aim should always be to make the easiest way out directly through the material to be moved or shattered.

Detonation

As has already been explained, dynamite is fired or "detonated" by means of the shock from a blasting cap or electric blasting cap, either of which is known as a detonator.

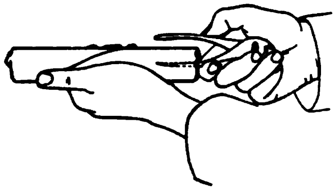
In order that the detonation may be complete, or in other words, that the full strength of the explosive be developed, the detonator should be placed inside the charge, with its closed or "business end" pointed toward the main bulk of the charge.

Priming With Cap and Fuse

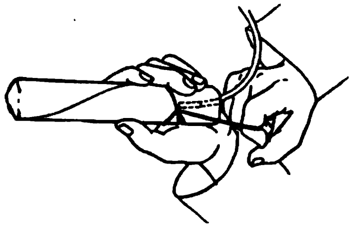
The act of placing the detonator in the charge is known as priming and the cartridge of explosive with the detonator in it is called a "primer."

In the preparation of the primer, when using fuse and blasting cap, examine your dynamite and see that it is not frozen. Frozen dynamite is hard and rigid, and dangerous to handle; when thawed it is soft. Next examine your fuse, see that it is not stiff and brittle; if in this condition it is advisable to warm slightly and cut the required length from the roll with a sharp knife or pruning shears. The cut should be made squarely across and not diagonally. Sometimes in the cutting the end becomes flattened, thereby making the end of the fuse too large to enter the blasting cap. When this happens squeeze the end round with index finger and thumb, open the cap box and allow one cap to slide gently into the open hand, but under no circumstance pick a cap out of the box with a piece of wire, stick, or other hard substance. See that there is no grit or trash in the cap. Slip the end of the fuse gently into the cap until it is against the charge in the bottom. Do not twist the fuse as the friction might cause a premature explosion. Then take the cap crimper and fasten the cap to the fuse with a crimp near the open end of the cap. These operations are not dangerous but should be done carefully. If the primer is to be used in a wet hole smear a little hard tallow, soap or similar substance, but not grease, around the top of the cap to insure against water leaking in and ruining the cap before it is fired. The cap is then ready to be inserted into the dynamite.

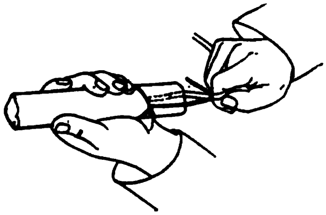
There are two reliable ways of doing this; in the side and in the end. To prime in the end of a cartridge, fold back the paper shell,



1. PUNCHING HOLE WITH HANDLE OF CAP CRIMPER

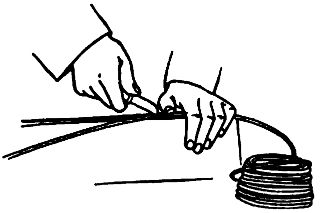


2. TIE CORD AROUND CARTRIDGE AND



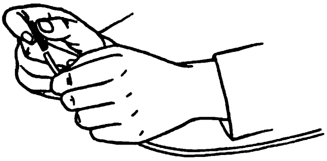
3. THEN AROUND FUSE

PRIMING IN END OF CARTRIDGE

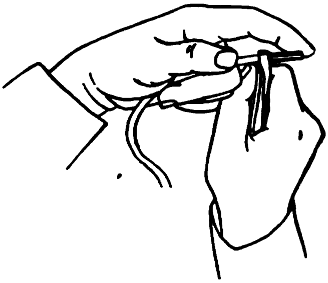


1. CUT OFF A SUFFICIENT LENGTH OF FUSE

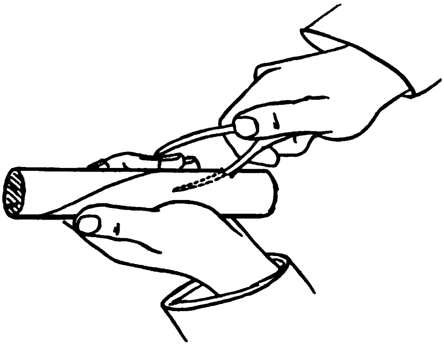
2. TAKE ONE CAP FROM THE BOX WITH THE FINGERS



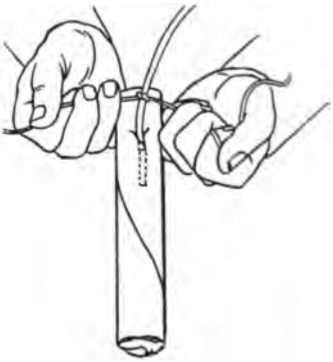
3. SLIP CAP ON END OF FUSE



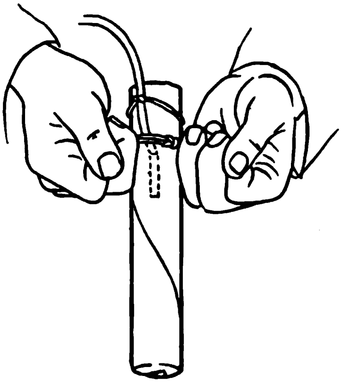
4. CRIMP CAP TO FUSE WITH CAP CRIMPER



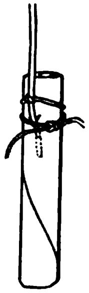
5. PUNCH A HOLE IN SIDE OF CARTRIDGE WITH HANDLE OF CAP CRIMPER



6. TIE CORD AROUND FUSE



7. COMPLETE BY TYING AROUND CARTRIDGE



8. COMPLETED PRIMER READY TO LOAD

MAKING UP A PRIMER

punch a hole at least two inches deep and ¼ inch in diameter straight down into the dynamite, insert the cap and fuse, fold back the paper and tie it firmly with a short piece of strong twine. This method has the advantage of having the cap pointed directly into the charge. It is graphically represented in the illustrations on page 91.

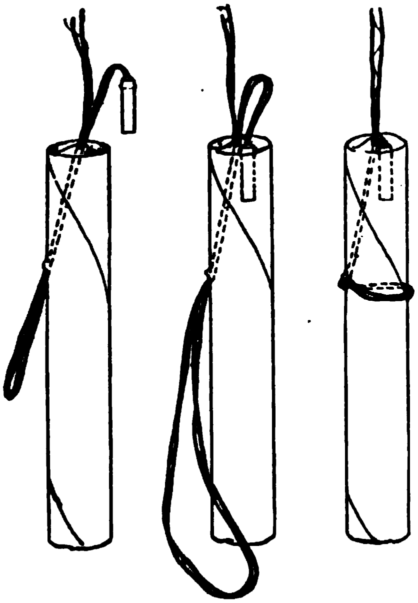
The other method is to punch a hole diagonally into the side of the cartridge, near the end and pointing toward the center, to a sufficient depth to receive the entire cap. Insert the cap with fuse attached and tie it there with a piece of cord. This method has the advantage of leaving a good place to apply the tamping stick in seating the primer in the hole, and is graphically illustrated on the opposite page.

The holes can be punched in the dynamite with the handle of the cap crimper, or with a wooden awl, and should always be deep enough to receive the entire cap and about ¼ inch of fuse.

When the primer is to be of only half a cartridge, as in subsoiling, it is good practice to punch a hole in each end of the cartridge and cut the cartridge in two before inserting the caps.

Priming With Electric Blasting Caps

When electric blasting caps are used they may be inserted into the dynamite as has been described for cap and fuse. Many blasters, however, prefer to use a slightly faster method, which has been found entirely satisfactory.



Punch a hole from the center of the end of the cartridge in a slanting direction so that it will come out at the side 2 or 3 inches from the end, insert the end of the doubled over wires of the electric blasting caps, loop these around the cartridge after which another hole is punched in the top a little to one side of the first and straight down. The capsule is inserted in this last hole as far as possible and the slack taken up on the wires, with the result that you have a primer where the wires do not cross each other at any point and the capsule is lying nearly in the axis and the cartridge hangs vertically, so that it is possible to load in the bore hole without its being caught on any roughness.

Never half-hitch the wires around a cartridge of dynamite, and when using cap and fuse never lace the fuse through the dynamite.

Cutting a Dynamite Cartridge in Half

When small charges are desired it becomes necessary to cut cartridges in half. This should be done with a sharp knife. Hold the cartridge firmly in one hand and the knife in the other. Giving the cartridge a rotary motion, ***cut the paper*** all the way around and then bend the cartridge slightly, when it will come apart just where the paper is cut. Never try to cut a frozen cartridge.

CUTTING CARTRIDGE IN HALF

Loading

When the cartridge is primed and the bore hole made, the next thing to do is to load. First try the hole with the tamping stick to see that it is open and will permit the charge being placed at the desired point.

When loading small charges, as when only a full or half cartridge primer is used for subsoiling or tree planting, start the primed cartridge into the bore hole and press it gently into place with the tamping stick. See that it is firmly seated in the bottom of the bore hole.

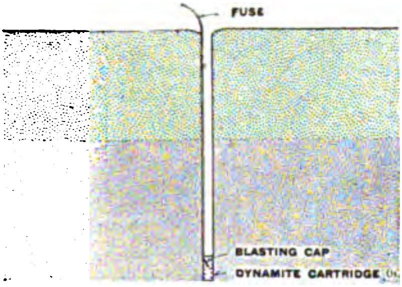
In pressing a primer into place, do not handle it roughly, as it contains the cap and is, therefore, more sensitive and dangerous than an unprimed cartridge.

When the load is to contain a larger amount of dynamite, press the unprimed cartridges in place in the bottom of the hole first, and place the primer with the cap pointed toward the rest of the charge on top. When the bore hole is dry, and it is desirable to have the charge concentrated in one place, it is a good practice to slit the sides of the cartridges with a knife or remove the paper entirely so that the dynamite can be compacted into a smaller space. The primer itself should not be split.

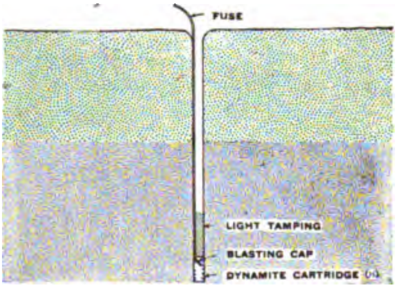
Tamping

Closing the top of the bore hole after the charge is placed is for the purpose of more closely confining the charge to insure better work and is called "Tamping." It should be made as tight as possible, so that the gases will not blow out as through the muzzle of a gun.

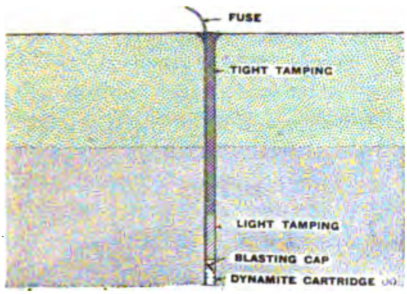
To guard against danger of prematurely detonating the charge, the first 5 to 8 inches of tamping should not be packed with any considerable force, but should be gently firmed. When this amount of lightly tamped material covers the primer, the rest of the tamping should be made as hard as possible, using the wooden tamping stick in one hand.



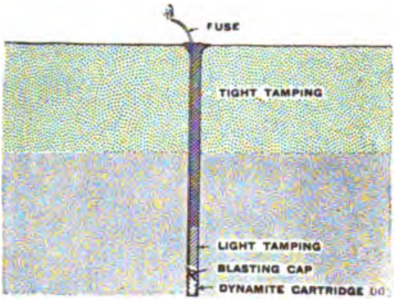
PRESS CARTRIDGE DOWN GENTLY; DON'T POUND



PUT IN 6 TO 10 INCHES OF EARTH AND TAMP LIGHTLY



TAMP FIRMLY TO THE TOP AND IT IS READY TO FIRE



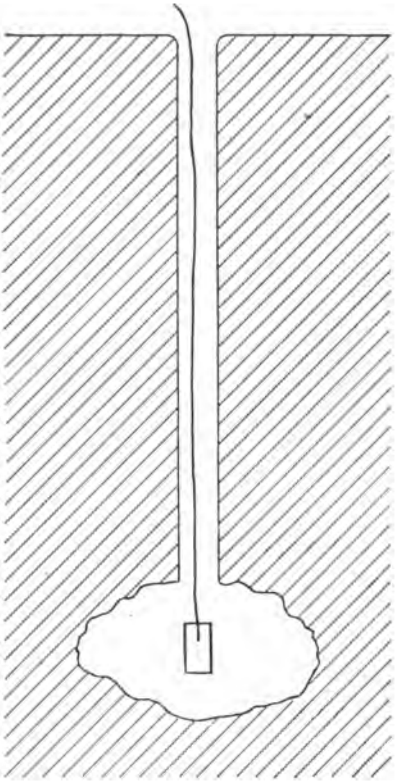
LIGHT FUSE AND RETIRE TO A SAFE DISTANCE

Moist clay, free from gravel and clods, makes good tamping material. Free running sand or moist loam is also good. In wet work, when a foot or more of water covers the charge in shallow holes, it will not be necessary to add other tamping, as the water will hold the charge sufficiently tight. Loading and tamping should be done in such a way that no open-air spaces are left.

When using soil for tamping, the hole should be tamped full. Do not allow sharp pebbles or stones to fall in the hole during loading and tamping.

Before beginning tamping it is well to measure the depth from the surface to the top of the charge, so that if the tamping must be removed to get at a misfire there will be no danger of disturbing the primer. It is a good practice, especially where heavy charges are used, to use two inches of paper or dry leaves for tamping immediately over the primer, so that they can be used as a safety marker, should the tamping need to be removed for any cause.

Springing a Bore Hole



Springing a bore hole. Showing position of dynamite charge before the blast and shape of enlarged hole.

When the bore hole, made for loading a charge of explosives, is not large enough to receive the desired amount, it can frequently be enlarged by firing small charges of dynamite at the bottom of the small hole. This is known as " springing " or " chambering " the hole. The extent of the springing will depend on how much the hole is to be enlarged and on the hardness of the ground encountered.

The first springing shot usually, in agricultural work, consists of from one-half to one cartridge of dynamite or stumping powder. If this does not make the hole large enough to receive the charge, wait until it has had time to cool, if the material blasted is of a nature that will hold heat and then use a second shot larger than the first.

Always give the hole time to cool before attempting another shot or before loading the charge, as the hot ground is liable to cause a premature explosion. Shots for springing are usually left untamped.

Springing is largely practiced in shooting big stumps, snakeholing boulders, and in shooting hard ground with black powder, and requires exercise of a very close judgment for successful blasting.

Firing

Exploding the charge is called " Firing," and can be done either by caps and fuse or by electric blasting caps. When cap and fuse are used cut the fuse long enough to enable you to retire to a safe distance. Fuse burns on an average of two feet per minute and a sufficient length should be used to permit of the blaster reaching a safe point before the explosion. When using electric blasting caps the leading wire should be long enough to enable the one who operates the blasting machine to be outside the danger zone. No blast should be fired until persons, animals and vehicles are well out of range.

When reliable explosives and blasting supplies are used, and the primers properly made and placed, misfires should seldom occur.

When using cap and fuse, and a misfire is noted, do not return to examine it at once, as an injured fuse may be burning slowly and delaying the shot. It is better to wait until the next day, if possible.

When using electric blasting caps there is less danger of delayed shots or misfiring. When one does occur, disconnect the wires from the blasting machine, and it will be safe to return immediately to the blast for investigation. Never connect the wires to the blasting machine until it is time to fire, and guard against a careless person tampering with the machine and leading wire while loading shots.

In selecting a safe place to watch a blast, do not get behind a tree or building, but stand in the open at a safe distance from the blast, so that you can see the flying fragments and dodge any that may come beyond reasonable bounds. Do not have the sun in your eyes, as it may obscure flying missiles.

Handling a Misfire

The use of high grade explosives and caps and careful loading will reduce the dangers of shots failing to fire. When a misfire does occur the blaster should be governed by conditions.

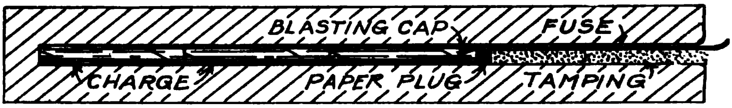
When electric blasting caps are used and one or all of the holes fails, disconnect the wires from the blasting machine, and it is safe to go back immediately to investigate the trouble. The investigation should first consist of a search for broken wires, faulty connections, or short circuits. If such are found, make the proper repairs, reconnect the leading wires and operate the blasting machine. Many so-called failures are the result of poor connections or connections being in contact with wet ground or other conductive material.

When caps and fuse are used greater care must be exercised. It is never safe to go back immediately to a delayed shot that is primed with a cap and fuse. The fuse may have been injured in tamping, and instead of burning rapidly may smoulder for a long time, then re-ignite the powder in the lower end of the fuse and fire the blast. The interval of waiting should be as long as possible, preferably until the next day if the firing is done in the afternoon. In all cases it should be several hours. When lighting fuse be sure that the powder column is on fire, as time may be wasted in waiting for a blast whose fuse is not even lighted.

If the hole is untamped or is tamped with water, make up another primer, place it on top of the charge, and fire. If the ground is soft and wet put down another charge far enough away for drilling in safety, but close enough to cause detonation by concussion. When this is not possible there are two methods of relief. The tamping can be carefully removed almost down to the charge with a spoon (See description on page 89) and hard wood probe. Great care must be exercised, especially when the cap is in the top cartridge of the charge, to prevent danger of firing the cap by friction or impact.

When it is necessary to blast out a misfire by drilling and charging a second hole, great care should be exercised. Such a hole must be far enough away from the charge to make drilling and loading safe, but must be close enough to insure the old charge being blown out together with the rock or confining ground.

When for any reason, misfires may be expected, a good practice is to use a wad of paper or dry leaves immediately over the charge of explosive and pack the tamping on top of this. If it becomes necessary to remove the tamping, this dry material makes an excellent index of just how far down it is safe to remove the tamping.



USE OF A PAPER PLUG TO BEGIN TAMPING

All misfires should be placed under the direction of a careful and experienced workman, who should make his examination in a slow, methodical manner before beginning the work of repriming.

As stated before, only the best explosives and supplies should be used, as they decrease the dangers of misfires, which always delay the work and increase the cost of the job.

The adoption of electric blasting will result in a decrease in delay or any misfires, and is to be recommended on all road work.

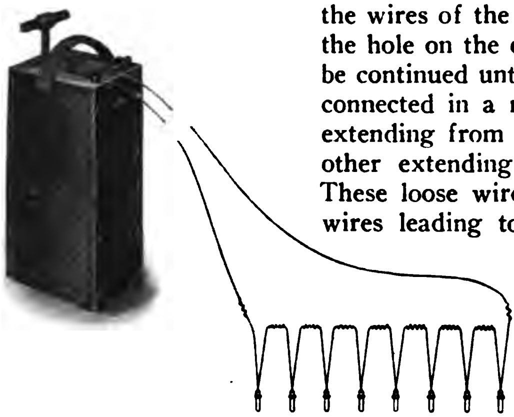
Blasting by Electricity

Large boulders and stumps with spreading roots can often be blown out and broken up more thoroughly and with less dynamite if the charge is distributed in several holes in different places under the boulder or stump and all of these charges exploded at one time. Groups of stumps standing close together can also be blasted in this way. In order to dig a ditch satisfactorily, it is always necessary to explode a number of charges simultaneously. In dry soils this can be done only by electric blasting. In well sinking and other kinds of blasting it is of advantage to explode a number of charges at one time, as each tends to help the other. The only way in which several charges some distance apart can be exploded at exactly the same time is by the electric method of blasting. Electric blasting may be applied to all of the work described in this Handbook, but it is generally unnecessary and more expensive, except in the blasting just described.

The equipment for blasting by electricity, in addition to the explosive, consists of

Electric Blasting Caps
Connecting Wire
Leading Wire
Blasting Machine

When the charges have been primed with electric blasting caps and tamped, the two copper wires protrude from the ground over each charge. These two wires should be separated and one of them connected to one of the wires of the next electric blasting cap on one side and the other one should be connected in the same way to one of



METHOD OF CONNECTING WIRES FOR ELECTRIC BLAST

the wires of the electric blasting caps in the hole on the other side. This should be continued until all of the charges are connected in a row with one free wire extending from the first charge and another extending from the last charge. These loose wires are connected to the wires leading to the blasting machine. This is called "connecting in series." If the holes are too far apart for the electric blasting cap wires to reach between them, pieces of connecting wire are used.

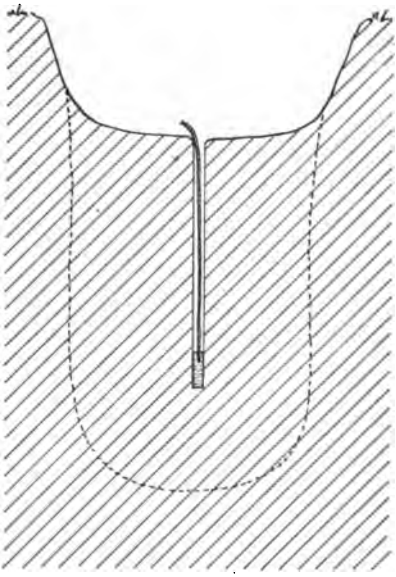
Connections are all made by twisting bare wire ends securely together. All wire ends should be scraped with a knife so that they will be free from grease or corrosion when connections are made.

All bare joints or other uncovered places in the wires must be kept away from water or damp ground. This can be accomplished by putting a stick, block of wood, or stone under the wire to hold it off of the damp ground.

BLASTING A POLE HOLE

Blasting Post and Pole Holes

Reductions in the cost of digging holes for fence posts, telephone, telegraph, and other poles, especially when the ground is hard, can be made by the use of explosives. The method of loading and the explosive used will depend on the nature of the ground and the depth of the pole.



Method of loading for blasting a shallow hole. The dotted line indicates the shape of the blasted hole.

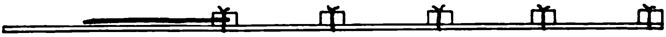
When blasting holes it is an excellent practice to shovel out the soft earth at the top to the full diameter of the hole, and to a depth of several inches or down to the hard soil.

Digging Shallow Holes

When the top soil is shoveled off, drive or drill a bore hole for loading, in the center of the shallow hole, to a depth a little less than the depth of the desired hole. Load this with a charge of from one-half to a full cartridge of Du Pont or Repauno Stumping Powder, primed with cap and fuse. It is usually best to leave the hole untamped. The blast will either shatter the hard ground so that it can be easily lifted out, or will pack it back and down out of the way.

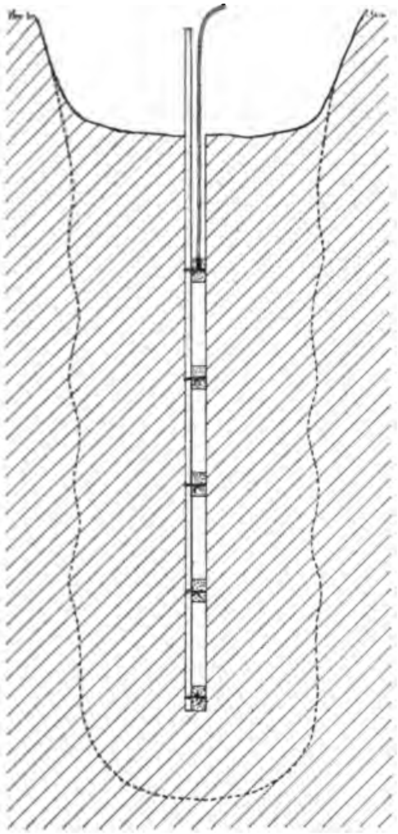
Blasting Deep Holes

For blasting deeper holes in hard ground or shale, heavier loading as well as a greater distribution of the charge is needed. This is obtained by tying small charges of a strong, and preferably a sensitive explosive, at regular intervals to a light lath, reed, or stick, as is shown in the following cut.



The lath must be as long as the hole is deep. Charges of one-fourth to one-half of a cartridge of 40 per cent. to 60 per cent. dynamite are tied at intervals of six to twelve inches. The top charge is primed with cap and fuse. This primer fires the bottom charges.

UNIV. OF CALIFORNIA



Method of loading to blast a deep pole hole. Note the dotted line as indicating the size and shape of the blasted hole.

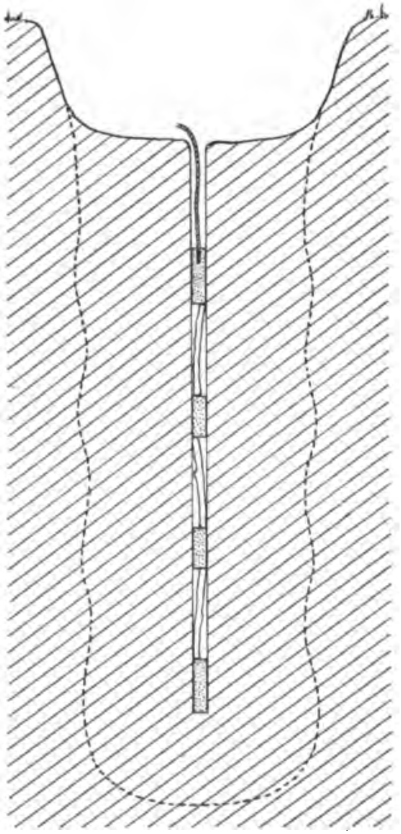
Red Cross Extra 40 per cent. to 60 per cent. dynamite can be used in cold weather, but Du Pont Straight 40 per cent. to 60 per cent. dynamite is to be preferred in warm weather.

When the top of the hole is shoveled out and a bore hole put down to the desired depth, this long charge is placed carefully in the hole, with the cap at the top. This cap should be fifteen to twenty inches below the surface. Care must be exercised that no dirt or loose trash gets between the charges, as it will prevent the firing of the bottom charges. The top may be tamped or left open, depending on how the ground shoots.

Another method of making up the charge is to roll the bits of dynamite in a long sheet of stiff paper. The primer is placed at one end as before. After rolling, the pieces of dynamite are held in place by pins stuck through from the outside.

Still another method is to clean out the bore hole, drop in the bottom charge, then a small stick broken to the desired length to hold the second charge at the desired height in the hole, then the second charge and another stick, and repeat until the hole is loaded.

Care must be taken to keep the



Method of loading a deep hole with small sticks to hold the dynamite in place. When rotten rock or shale is encountered, the loading must be heavier.

sticks from slipping by the charges and letting them down too low; and to prevent the holes becoming plugged up. The sticks must be small so that they will not fill up the hole.

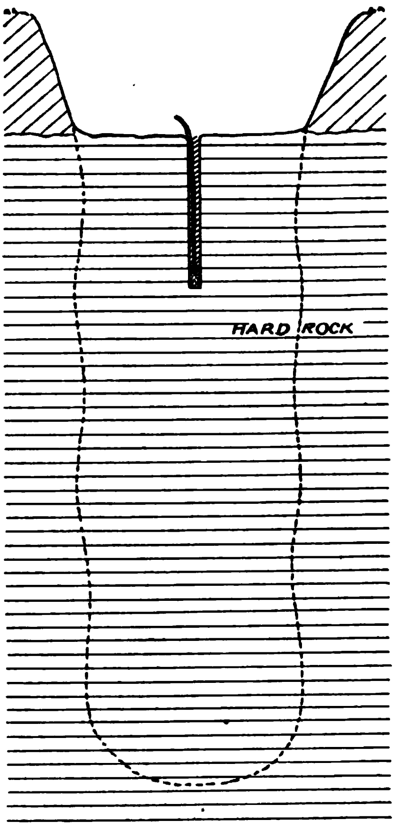
When the ground is a hard clay, better results are obtained if the soil is wet.

Reports on holes blasted in this way are as follows:

Holes to be 4½ feet deep. Ground, hard clay. One-third cartridge Du Pont sixty per cent. at bottom, same twelve inches up, same twelve inches up with cap. Hole untamped. Results good. Hole, clean and open.

Five quarter cartridges Du Pont sixty per cent. dynamite, spaced six inches apart, beginning at bottom. Cap in top. Hole untamped. Results good. Hole uniform at top and bottom, and dirt blown out.

Blasting Holes in Solid Rock



In hard rock the bore hole must not be deep. After the first blast, clean out the fragments, and drill a second hole. The dotted line indicates the shape of the blasted hole.

As it is impossible to force back the size of the holes in solid rock, as is done in blasting in hard clays, modifications in the method of loading are required. Ordinarily, holes are not put down so deep in rock as in hard ground.

After excavating the holes down through the soil, if any is present, drill a hole from twelve to eighteen inches into the rock, load this with a full cartridge primer, press well to the bottom, tamp the hole tight, and fire.

If the loading is heavy enough, this will shatter the rock to full depth of the blast. When loose fragments have been removed, drill another hole to the same depth, and load as before.

The explosive used for this work should never be of a lower strength than Red Cross Extra 40 per cent. dynamite, and for hard rock 50 per cent. or 60 per cent. dynamite is often better.

The methods of making up primers are the same as for other work. See pages 91 to 93.

The application of these methods of digging holes is proving a money and time saver. The tamping of poles in blasted holes is found to be easy and fast.

The Du Pont Company has a bulletin, "Blasting Pole and Post Holes," that will be sent on request.

Breaking Ice and Log Jams

Serious trouble and inconvenience is often caused in ponds, streams, and spillways by jams or gorges of logs and ice. These often cause serious inconvenience and danger by backing up the flow of streams and endangering bridges and other property. Relief is by blasting.

Ice Blasting

Often in Spring when ice in streams starts to move, it gets choked in narrow parts of the stream or by some natural or artificial obstruction. Then an ice gorge or jam is formed which causes the water to back up, flooding the surrounding territory above and often carrying away bridges and other structures and causing considerable damage.

By the use of explosives at the proper time the damage can often be averted. Ice begins to move out in various localities about the same time each year. Usually there is sufficient warning when to expect the break to occur, by several days' thaw or rains. It is a good plan to anticipate the moving out as soon as the Spring thaw begins, by blasting the ice while intact on that section of the stream where the gorge or choke usually occurs. The method of procedure is as follows: With ice spuds or cutters and bars, chop holes about six inches to eight inches in diameter through the ice to the water. Holes should be spaced from fifteen feet to twenty feet apart.

A charge of from six to eight cartridges of low freezing explosives 40 per cent. strength should be lowered in each hole so that the explosive is in the water and below the ice. The cartridges can be tied together in a bundle, and one cartridge of each bundle should be primed with a No. 6 Electric Blasting Cap. To prevent the loss of the charge the wires can be fastened to a stick of wood laid across the hole on surface of the ice. Several holes should be connected together in series and fired with a blasting machine.

It has been found that the ice is broken up more by the wave action of the water than when the charge is imbedded in cracks or holes dug in the ice. It is best to fire the holes electrically, but if no blasting machine is at hand a cap and fuse will answer, but then only one hole at a time can be fired.

If this is done all through the narrow section the ice is practically "honeycombed," so that when the water and ice from above comes down, it gives way readily and causes no damage.

If the gorge or jam has actually occurred a charge of from five pounds to twenty-five pounds of dynamite should be loaded in a crevice, or dug hole, at what appears to be the weakest part of gorge. Several such charges can be distributed at various points in the gorge and connected together and fired electrically. If the first blast does not start the gorge, the same process should be repeated with increased charges until it gives way.

To break up floating ice so that it will not bank up, forming a gorge, charges of dynamite can be exploded on the surface of the ice, the size of the charge depending on the thickness of the cakes.

If they are large blocks it may be possible to get on the ice from shore or boats and successive charges of several cartridges can be exploded with fuse and blasting cap until the ice cake is properly broken.

If stream is narrow the charge of explosives can be thrown on the ice from the shore, or, if running swiftly the charge can be dropped on the floating cakes from down-stream side of bridges. The dynamite should be tied in a bundle and one cartridge in each bundle primed with a blasting cap and fuse. A block of wood or stone can be tied to charge as an anchor to prevent its rolling off the cake of ice. The fuse should be lighted before thrown and ample length allowed for a get-away. Fuse burns about two feet per minute, so from two feet to three feet is sufficient. The place where fuse enters blasting cap should be smeared with soap or grease to protect charge in cap from water.

Watering places for stock along the banks of streams can be easily kept free from ice in winter by the use of a little dynamite from time to time.

Blasting Log Jams

For relieving log jams the best practice is to carefully examine the trouble in an effort to locate the point that is acting as an anchor or tie for the jam. Then load this with a heavy charge of dynamite that will blow out the confinement. In cold weather only low freezing explosives should be used. Electric firing is advised so that the loader may have plenty of time to get to a point of safety. A few years ago a large jam of logs and ice had formed a dam in the Eau Claire River

BLASTING OUT A LOG JAM WITH DU PONT DYNAMITE AT BIG FORK, MONTANA that was backing up the water to such an extent that the City of Eau Claire was seriously threatened. A blast, such as has been described, relieved the trouble in an instant.

In loading shots of this nature, the services of an experienced shooter should be obtained if possible. The loading should be only as heavy as the nature of the work requires. Half-hearted attempts using light loads can but spell failure and disappointment.

Scrapping Old Machinery

Breaking up old machinery, such as heavy castings or steam boilers, can be readily done with dynamite.

For scrapping a boiler use only 40 per cent. or stronger explosives. Remove the dynamite from the shell and distribute in a continuous cord about half an inch in diameter all the way around the boiler, and secure it with a heavy mudcap. This can be placed along one of the seams more easily than on the smooth plates. When detonated such a charge will cut the plates almost as neatly as a shearing machine, and will reduce the cumbersome boiler to a size that can be handled.

For breaking heavy castings mudcapping is practiced the same as on boulders. Sometimes a hole in the casting can be used for a block hole and loaded as described on page 20.

The accompanying illustration shows a large cast retort that was broken by filling with water and firing a small charge of Red Cross submerged well under the surface.

EMPORIUM, PA., March 30, 1914.

Mr. George Frank Lord, Managing Editor, Du Pont Magazine, Wilmington, Del.:

DEAR SIR:—I hand you herewith a set of pictures showing our method of breaking cast-iron retorts weighing 6,000 pounds each with Du Pont Dynamite, Red Cross Extra 40 per cent., using a stick 1¼ x 4 inches in size, and one 4-foot No. 6 Du Pont Electric Blasting Cap to each retort.

THE RETORT BEFORE THE BLAST

THE RETORT AFTER THE BLAST

The retorts are filled with water and the cartridge is suspended in the retort and fired. In this manner we broke the 18,000 pounds cast scrap with ¾ pounds of dynamite and three electric fuzes.

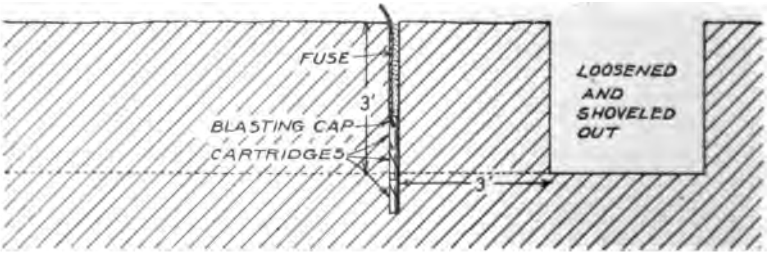
Trusting this may be of value to you for the Du Pont Magazine, I am,

Very truly yours,
W. W. WEIMAN.

Excavating Cellars and Foundations

The digging of cellars and other kinds of pits can be hastened by blasting if the work is properly done.

When it is necessary to make such excavations in rock, the first or "cut" shot should be made with a circle of holes running down to a point as has been described for well shooting. After one small section is down to the required grade the rest of the holes should be drilled straight down. These should be spaced back a distance equal to the depth of the cut and spaced about the same distance apart.



METHOD OF LOADING FOR DIGGING A CELLAR

When the cut is more than 6 feet deep, the spacing should not be as great as the depth, as more than six feet is hard to blast off. The hardness of the rock will have much to do with the amount of explosives required.

In reasonably hard rock the drill holes should be loaded a little more than half full of Red Cross Extra 40 per cent. dynamite or Du Pont or Repauno Stumping Powder, removed from the shells and tamped tight. Better results will be obtained with electric blasting, because then several charges can be fired together, giving a cumulative effect.

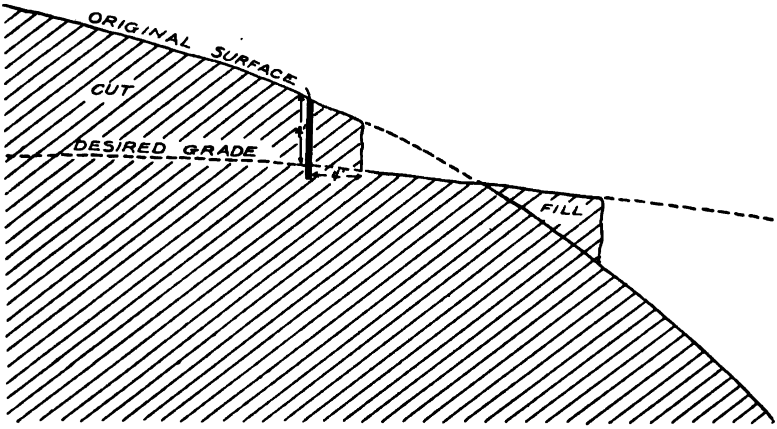
In tight clay an opening can be started with a single hole not quite down to grade and loaded with enough dynamite to blow out a conical shaped section of earth. After this is cleaned out, the rest of the holes can be loaded much the same as for the rock described above with lighter charges.

See pages 94 to 96 for correct methods of loading and firing.

Road Building

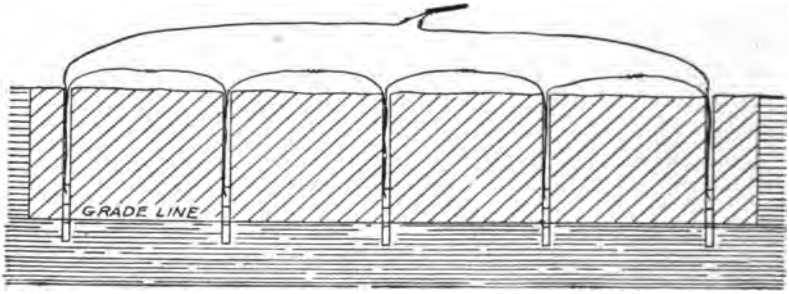
A rational use of explosives in road building for clearing the right of way, blasting protruding stone from the surface or from the sides of cuts, making cuts through stone or tight clay, digging ditches, reducing grades, widening cuts, and various other purposes, will hasten the completion of the work and reduce the cost.

The methods already described for stumping, boulder blasting and ditching, are equally applicable to this class of work. The loosening of tight clays in reducing grades is done in exactly the same way as in digging cellars described under another heading.



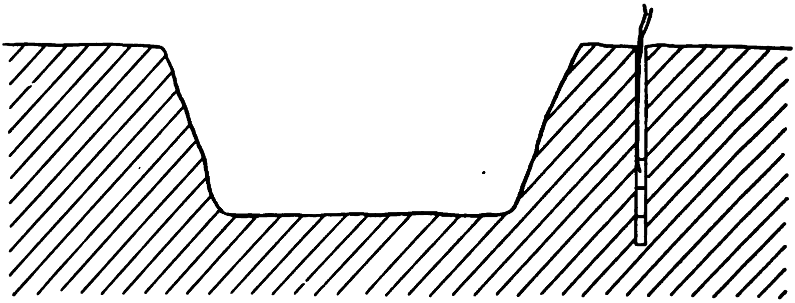
METHOD OF LOADING FOR ROAD GRADING OR SIDE HILL CUTTING

In starting in a rock cut the ordinary practice is to drill the holes a few inches below the desired grade. These holes should be spaced back and apart a distance about equal to the depth of the cut, unless the holes are more than six feet deep, when the spacing should be about six feet. Each row of holes should be fired simultaneously with electric caps and a blasting machine.



METHOD OF LOADING IN MAKING A CUT THROUGH ROCK OR HARD GROUND

The Du Pont Company has prepared a complete text on road building, in which specific directions are given for doing different kinds of road work. A copy of this can be had on application.



LOADING TO WIDEN A CUT

Sinking Wells

Wells are often sunk through rock or ground which cannot be dug to advantage without the aid of explosives. When rock is reached and the earth above is properly supported, a circle of four or five drill holes should be started about half-way between the center and the sides of the well and pointed at such an angle that they will come closer together near the center when they are three or four feet deep. These holes should be loaded about half full of Red Cross Extra Dynamite 40 per cent., with damp clay or sand tamping packed firmly above to the top of the hole and then exploded all together from the surface by electricity. This shot will blow out a funnel-shaped opening in the center, and the well can then be made full size with another circle of holes drilled straight down as close to the sides as possible. If the well is large it may be necessary to drill a circle of holes between the inner and outer circle. The above process should be repeated until

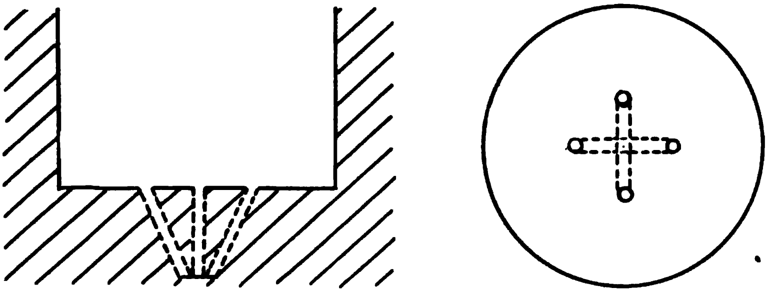
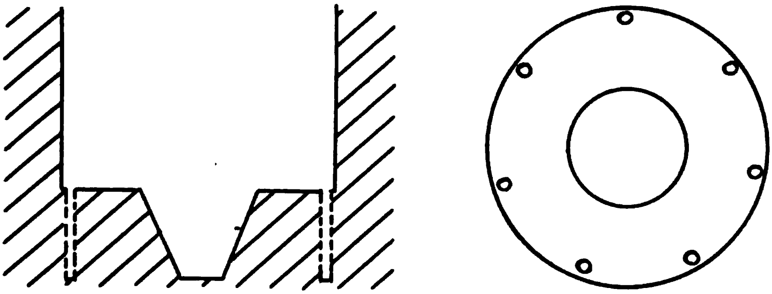


DIAGRAM OF LOADING A CUT SHOT IN A WELL



THE EXCAVATION IS COMPLETED BY A CIRCLE OF HOLES NEAR THE WALL

the well has passed through the rock or has been sunk to the necessary depth. Do not in any case enter a well until all the fumes of the last blast have come out. If in doubt, lower a lighted candle to the bottom; if it continues to burn the well may be entered safely. Electric blasting caps will give the best results.

Shooting Wells to Increase the Flow of Water

Often drilled or dug wells do not give a sufficient flow, the water being confined in a number of small veins or fissures that do not discharge into the well. The object of shooting a well is to open up these veins or fissures so that all of the confined water is brought together. Where such formations are found successful blasting will usually result in increasing the flow.

Where wells are drilled in dry, non-water-bearing rock, shale, clay or gravel shooting will not produce a flow.

The services of an experienced well shooter should always be secured, and well shooting should never be attempted by the novice in the use of explosives. The Du Pont Powder Company will be glad to correspond with those having work of this kind to do and who cannot get the services of a competent shooter. In writing for information be sure to answer all of the following questions:

For Drilled Wells

1. Location of well.
2. How many feet is well from nearest buildings?
3. Kind of buildings.
4. Diameter of well in inches.
5. Diameter of casing in inches.
6. Depth of well in feet.
7. Depth of casing in well in feet.
8. How many feet of water in well?
9. Describe the different kinds of soil, rock and other material you went through in drilling the well, and give the location and depth of each class of material.
10. Can the water be partially or entirely exhausted from the well?
11. What is the maximum number of gallons of water the well will furnish in an hour?

For Dug Wells

1. Depth of well.
2. Diameter of well.
3. Type of curbing.
4. Character of rock below the bottom of the well.
5. Has the well always given a poor flow or has the trouble developed recently?
6. Are there any neighboring wells on land as high as yours that are giving a good flow? If so, how deep are they?

In answering these questions be sure to describe each condition fully. Also give any other possible information that might assist in diagnosing the trouble.

Tree Planting

How to Do

The methods employed for making boreholes and loading for tree holes are exactly the same as those given for shattering subsoil and hardpan. The explosives advised are Du Pont or Repauno Stumping Powder. The depth and amount of loading should be similar to that given on page 51, making the necessary variations in quantity of dynamite.

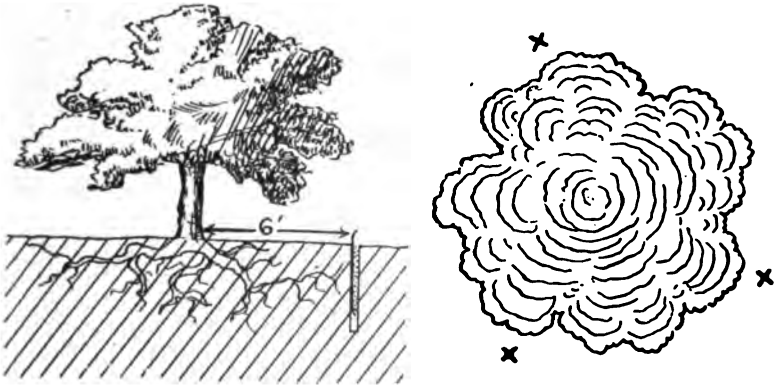
The common practice is to plant the trees shortly after the holes are blasted, in which case it will be necessary to examine the bottoms of the holes and fill any pothole created by the blast with soil to prevent the trees settling too deep after the first heavy rains. (See illustrations, showing every step of the work on pages 47 to 53.)

Another practice, and a good one, especially for Spring planting, is to blast the holes during the late Summer or Fall, and allow them to stand without further treatment until planting time.

Where the soils are deficient in plant food or humus, a bushel or more of well-rotted manure should be put in the holes and allowed to mix with the soil during the winter. The addition of a handful of finely ground limestone should also be used if the soils are sour.

Cultivating or Rejuvenating Old Fruit Trees, Shade Trees, Vines and Bush Fruits

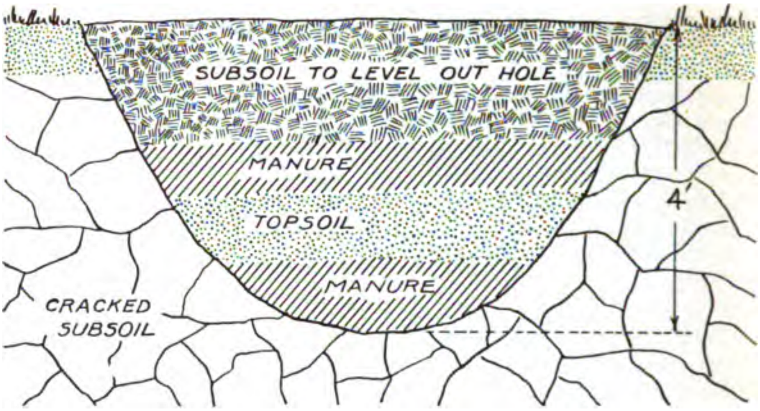
The object of blasting around old trees and vines is to open up the subsoil so that the roots may spread farther and go deeper, to increase the amount of plant food available for the roots, to establish better drainage and to increase the water-holding capacity of the soils. Blasting around root-bound trees or in resistant subsoils is strongly advised. The actual blasting is similar to the blasting for subsoiling and tree planting.



For Small Tree

For Large Tree

LOCATION OF CHARGES FOR REJUVENATING TREES



METHOD OF TREATING BLASTED HOLES IN POOR SOILS

Ordinarily it is better to blast on one or two sides of a tree the first year and blast on the remaining sides one or two years later. The blasts should be placed not closer than six feet to small trees, and should be slightly beyond the spread of the branches in large trees.

Where the subsoils are deficient in plant food or humus, excellent results are obtained by putting down holes a few feet beyond the spread of the branches to a depth of about 4 feet and loading them with a sufficient amount of explosives to blow out a hole. This should then be filled with alternate layers of manure and soil, or with a mixture of manure and a suitable fertilizer.

Where trees tend to develop a strong tap root, but are stunted by a stratum of hardpan lying immediately under them, relief can be had by starting a hole two or three feet away from the trunk and driving it diagonally under the tree into the hard material. Unless this hole is three or more feet deep the charge should not exceed one-fourth of a cartridge of Stumping Powder and not over one-half a cartridge even then. Great care must be exercised in this method of loading, not to loosen or blow out the tree. Except in extreme cases, we advise the loading to the side.

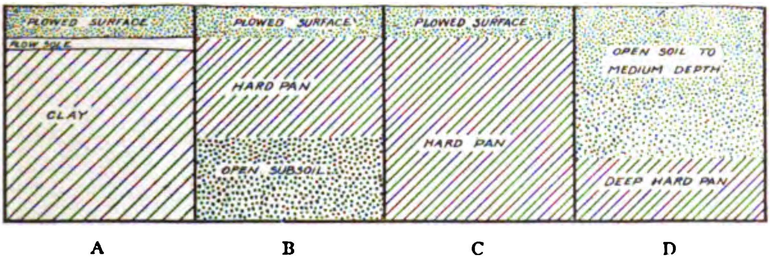
When blasting around or under growing trees materially prunes the roots, the tops should be cut back to temporarily reduce transpiration to correspond with the reduced ability of the roots to obtain a sufficient amount of moisture. The roots will then put on vigorous growth and absorb increased amounts of plant food and moisture to nourish an increased growth of top, and, in case of fruit trees, an increased production of fruit will result.

See pages 94 to 96 for methods of loading and firing.

Shattering Subsoil and Hardpan

Plowing and cropping the same soil year after year robs the top soil of much of its original plant food. Impervious clay subsoils and hardpan prevent deep rooting of plants, and the percolation of water into the subsoil where it should be stored to carry the crops through the dry spells that occur nearly every summer. When such soil conditions are corrected, even to a depth of eighteen inches by mechanical means, marked increases are noted in the crop yields. These benefits can be materially increased by making the tillage four to six feet deep with Du Pont or Repauno Stumping Powder.

In doing this work the best results are obtained by spacing bore holes about 15 feet apart to a sufficient depth to permit the shattering of the impervious material. In deep clays of uniform nature, such as is represented in Sections A and C of the accompanying sketch, the holes should be put down to a depth of about 3 feet. Where the hardpan material is similar to that in Section B the holes should be put down a little more than half way through the hardpan. They should not go below the hardpan, as there is danger of the blast lifting the hardpan in large chunks, rather than shattering it. Where it is desirable to shatter soils similar to the one represented in Section D, the holes should be put well down into the deep hardpan, the depth being governed by the depth of the open surface soil. Each hole is charged with a half to a full cartridge of the explosives mentioned above. Exact advice for putting down the holes and charging them is given in the text and illustrations on pages 50 to 52, and directions for making the primer are given on pages 91 to 93.



DIFFERENT TYPES OF HARDPAN

In some cases of hardpan like cemented gravel or hard shale, slight variations must be made in the method of loading. In such cases it will be better to materially increase the amount of explosive used and to study each hole carefully before loading.

Subsoil blasting should be done only when the subsoil is dry, because wet subsoils are difficult to shatter, and the tendency of the explosion is to create a large cavity or pothole at the base of the blast. This does not benefit the land. Where the soil, as in " A," has a loose subsoil, destroy the plow sole by deep surface tillage and blasting will not be necessary.

Blasting to Increase Action of Tile Drains

Often tile drains are properly laid so far as engineering is concerned, but fail to drain the land because the subsoil is too impervious to permit the water, except that from the soil immediately disturbed in digging the tile trenches, reaching them. To correct such a condition the subsoil should be cracked so that the excess water can seep into the drains and be carried away. This is done by subsoil blasting, using slightly lighter charges than is ordinarily advised. Care must be taken to place the charges not closer than 9 or 10 feet to the drains.

A better practice on such soils, especially where the hardpan is too deep to be thoroughly reduced by blasting, is to shatter the subsoil to a depth greater than the drains are to be laid before the ditching for laying the tiles is begun. Instructions for priming, loading and firing are given on pages 91 to 96.

Before undertaking work of this nature a very careful study should be made of the nature and depth of the hardpan. Care must be exercised at all times if the best results are to be obtained.

This class of blasting becomes very important in draining certain classes of heavy clay, and in deep tilling hardpan in an effort to wash out alkali. A graphic illustration of the effects of blasting around tile drains is given on page 71.

VIEW OF ROCKY PACIFIC COAST HILLSIDE WHERE BOULDERS ARE TO BE BLASTED IN PREPARATION FOR TREE PLANTING

"Sub-Soiling with Dynamite"

CONDITIONS

Governing a contest between the Students of the Agricultural Colleges of the United States

Season of 1911

SUBJECT

"Sub-Soiling with Dynamite"

DU PONT

Conditions governing a contest

of

"Sub-Soiling with Dynamite"

between the Students of the Agricultural
Colleges of the United States

Season of 1911

DURING the latter part of 1909 we advised several agricultural colleges regarding prizes we would offer to their students, who desired to enter a contest by writing an essay on "The Use of Explosives in Blasting Stumps, Boulders, Breaking Up Hard Pan and in Tree Planting." The contest we found of much value to ourselves, and believe that it created an interest in the use of explosives on farms of agricultural colleges which could not otherwise have been attained. With this idea, we are this year submitting the plan outlined in the following pages to the various agricultural colleges throughout the United States.

We will divide the United States into four groups as follows:—

GROUP 1.

Maine
New Hampshire
Vermont
Rhode Island
Connecticut
New York
Pennsylvania
New Jersey
Delaware
Maryland
Virginia
West Virginia
Massachusetts

GROUP 2.

Ohio
Indiana
Kentucky
Michigan
Wisconsin
Illinois
Minnesota
Iowa
Missouri
North Dakota
South Dakota
Nebraska
Kansas

GROUP 3.

North Carolina
South Carolina
Georgia
Florida
Tennessee
Alabama
Mississippi
Arkansas
Louisiana
Oklahoma
Texas

GROUP 4.

Montana
Wyoming
Colorado
New Mexico
Idaho
Nevada
Washington
Oregon
California
Utah
Arizona.

To each of these groups we will offer the following prizes:—

First Prize	**$300.00**
Second Prize	**200.00**
Third Prize	**100.00**

The above prizes are offered, provided there are **more than three contestants** in each group; and also provided the papers submitted are of such merit in the eyes of the Committee of Awards as to be given prizes.

In the event that there are less than three contestants in each group, prizes will be awarded the papers submitted according to their merits in comparison with papers submitted from other groups.

Other smaller prizes will be offered for papers from each group, if more than three papers are submitted from each group, and provided there is enough merit in the papers, in the eyes of the Committee of Awards to warrant this.

In addition to these three prizes for each group, we will offer an additional prize of a Gold Watch, value **$100.00**, to the student in all the four groups who shows the best results.

The conditions of this contest would be as follows:—

FIRST:—The subject of the paper to be submitted by the participants will be "Sub-soiling with Dynamite." Any student of any college giving an agricultural course can enter this competition.

SECOND:—It will be necessary for each participant to cultivate a certain sized plot of ground, preferably an acre, half of which plot is to be dynamited, the other half not dynamited. The entire plot is to be planted with the same kind of crop and fertilized and farmed alike.

When a student has decided to enter this contest, it will be necessary for him to register his name and address, and location of plot. Also to advise us the size of the plot, and the crop he is to cultivate on said plot before April 1st, 1911. All of this to be certified to by the President, Dean, or a Professor authorized to act for the President of the Agricultural College, this certification to be made on a form similar to the attached.

THIRD:—Photographs are to be taken of this plot at different times during the season, and from two different points, which will show two distinct views of the plot. **All photographs submitted are to be taken from these same two points.**

Photographs are to be taken immediately before any work has been done on the plot, also immediately after half has been dynamited and thereafter every thirty days. These photographs are to show as far as possible the actual condition of the field before starting the work, and also immediately after the blasting has been completed. Succeeding photographs are to clearly indicate the growth of the crop on the half blasted, and on the half not blasted. The photographs are to be taken on films or plates of not less than 3¼″ x 5½″, but preferably on films or plates 5″ x 7″. The participant is to send to the Technical Division, E. I. du Pont de Nemours Powder Co., Wilmington, Delaware, two prints of each photograph taken. One print is to be mounted, and must show on the back the date photograph was taken, name of the participant, address, and very briefly the condition of the crop raised. **Nothing is to be pencilled, printed or attached to the unmounted photographs.** These photographs must be sent in promptly after having been taken. We will agree to reimburse the participant for these photographs immediately on receipt of the expense papers from the student, providing the cost per print does not exceed 50c. to 75c. according to size.

FOURTH:—In dynamiting one-half the plot selected, we will agree to reimburse each participant for the dynamite purchased for this work up to 100 lbs., and also the necessary fuse and blasting caps, provided, however, they send us vouchers showing they purchased from a local dealer Du Pont Explosives only, (Red Cross brands recommended), showing the dynamite to be Du Pont, and also showing grade markings, size of cartridges and amount of explosives purchased.

FIFTH:—In considering the awarding of prizes, the committee of awards will be guided not only by the crop raised on the plot selected by the participant, (he to keep separately the amount raised on the blasted portion and the amount raised on the unblasted portion,) but they will also consider the intelligence displayed in the preparation of the paper, compilation of the data and, in fact, the whole subject from the time the student starts to prepare the ground until the crop is harvested, together with the manner in which the information is given us in his papers.

SIXTH:—The papers should give in detail, the character of the soil for at least a depth of three feet, the fertilizer used (if any), and the amount, the way the plot was cultivated, how often it was cultivated, in what manner it was cultivated, to what depth it was cultivated and the manner in which one-half was blasted. With regard to the half blasted, we should have details regarding the amount of explosive used per bore hole, the depth of the bore holes, their distance apart, the method employed in drilling or driving them, and the results.

SEVENTH:—This contest is not limited to any certain crop; that is left to the choice of the student, provided he notifies us on certificate to be found on last page.

EIGHTH:—Our representatives are to have the privilege of inspecting the plot at any time. We further reserve the right to make use of the papers submitted, results obtained, etc., for advertising purposes, should we desire to do so.

NINTH:—This contest will be for the year 1911 only, and papers should be submitted not later than Dec. 1, 1911. Students in submitting these papers will place their card, with a nom de plume written thereon, in a small sealed envelope. This small envelope, together with their paper, must be placed in a suitable sized envelope, on the outside of which will be written the nom de plume assumed by the student. This is then to be enclosed in a large envelope, and to be mailed to the Technical Division, E. I. du Pont de Nemours Powder Company, Wilmington, Delaware.

TENTH:—To any student, we will gladly send any of the following pamphlets, upon request:—

Farmers' Hand Book
Red Cross Explosives
Tamping.

Copies of these three pamphlets have been sent to the President of each college.

E. I. DU PONT DE NEMOURS POWDER CO.,

DU PONT
Established 1802

Wilmington, Del.

February, 1911.

Issued January 1, 1912

DU PONT DEPARTMENT OF AGRICULTURE

FARMERS' BULLETIN No. 1

Agricultural Promotion Work

I

The Breath of Life or Underground Air

How Root Growth Is Developed	Ventilation Hastens Crop Maturity
The Necessity of Soil Aeration	Increases Soil Fertility
Makes Plant Foods Available	Insures Better Crops

JANUARY, 1912

PREPARED IN THE OFFICE OF
J. H. Squires, M. S., Ph. D.

DU PONT

WILMINGTON
DELAWARE
1912

IF IT costs the value of twenty bushels of corn to raise and market an acre of corn, you are doubling your profits by increasing the yield from 25 bushels to 30 bushels or from 40 bushels to 60 bushels.

The Breath of Life

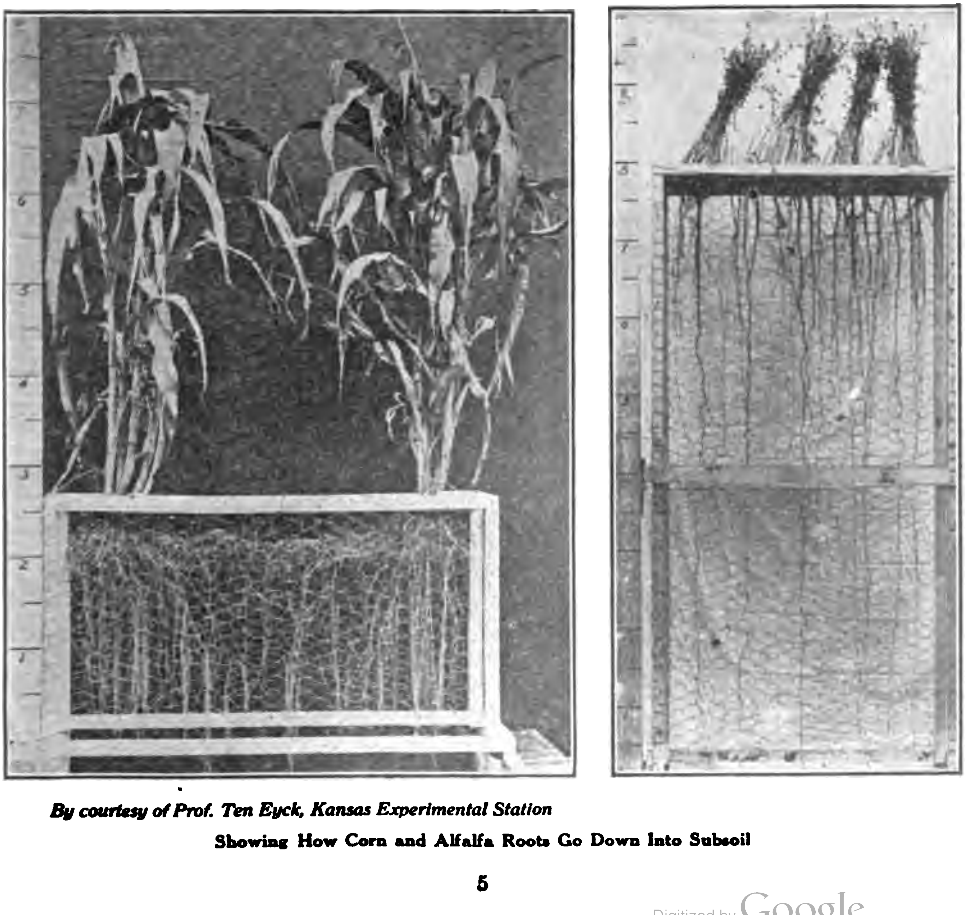
A Few Facts About the Effects of Air in the Soil

DU PONT

The Breath of Life

Everyone is familiar with the way in which animals breathe, but many never stop to realize that plants—the ordinary corn, cotton and grass in the fields—have organs of respiration that are just as elaborate as those of animals. The nostrils and the lungs of the animals are replaced in the plants by tiny openings in the leaves, and roots that have such thin coverings that they can absorb air. The leaves have at all times an abundant supply of air from which to draw just what is wanted, but the roots are not at all times so favored. If the roots are insufficiently supplied with air they are not able to do their work properly and the leaves are held in check at the same time by the faulty development of the roots.

Some of the things that are necessary for the proper development of the roots are: air, moisture, foods that will dissolve in the soil water, temperature that is not too cold, and a soil in which it is possible to spread out and grow easily.



By courtesy of Prof. Ten Eyck, Kansas Experimental Station

Showing How Corn and Alfalfa Roots Go Down Into Subsoil

Most of the breathing of the plant is done by the leaves, yet a small but necessary part is carried on by the roots. This renders it necessary that the soil be well ventilated by numerous small openings between the particles. Such openings can readily be seen by looking closely at a glass filled with shot or small gravel. Little flues or ventilator shafts are formed throughout the mass by the particles not being able to fit close together. In well tilled soils that are growing heavy crops there are many of these little chimneys; from one to two-thirds of the volume of a good agricultural soil will be found to be made up of these tiny openings.

The heavy soils or sub-soils will be found to be made up differently. Many of the openings have been entirely crowded out and those remaining are so reduced in size that they allow little, if any, passage of air to supply the different types of life in the soil.

The water-logged or very wet sub-soils act just the same as the packed soils in excluding the air; for the air cannot pass down through openings choked up with excessive amounts of water. Some plants, like cypress trees, overcome these conditions by root modifications which allow breathing, but the crops growing in the field and garden cannot do this so it is necessary to furnish them air down in the ground.

Cypress Swamp Showing "Knees" Absorbing Air For Roots

AIR AND FOOD

The plant root must also take up from the soil all the mineral foods needed for its development. These must be in such form that they will dissolve in the soil moisture readily enough to keep the plant from starving.

Many of the minerals furnishing these necessary foods are too slowly dissolved to be of benefit to the plant until they are acted upon by the air and are caused to undergo very great changes. These changes are brought about but slowly in tight clay soils, sub-soils and hard pan. While these changes in the nature of the minerals are being made by the air, great hosts of small bacteria are assisting in the same work; some helping to break down one mineral and some another. These classes of bacteria must have an abundant supply of air, for if caused to remain for any length of time in foul air or without air, they die and are replaced by others that may set about to undo the work already accomplished.

There are two very distinct classes of bacteria in the soil. One may be described as air-breathing or air-loving, the other as not air-breathing. It is the first class, those that need air, that are the farmers' friends.

In addition to the work already described, in which they assist in breaking up or changing the minerals needed by the plant and leaving the food so that it can be dissolved by the soil water, they do many other things: some of which are to work in the manure added to the soil; in the leaves left on the surface by the last crop; in the roots and any remnants of plants or carcasses of animals, and make from them some of the choicest dainties to supply the ever hungry roots of the plant.

It can be readily seen that the effects of fresh manure or litter are entirely different from those of well decomposed litter or manure that has lain in the soil for some weeks and undergone a course of decay. One is able to give itself up to the plant with ease, simply because it has been broken down and digested for the little roots by the ever working, air loving bacteria; the other must first undergo a change.

Root Hairs for Absorbing Moisture

There are two very different kinds of rotting; one being called decay and the other putrefaction. Both are brought about by the bacteria of the two classes already described. Illustrations of both are to be found all around. In one case we have the slimy, ill smelling putrefaction in the soils from which the air is excluded by water or on account of its closely packed condition. This leaves, after decomposition, a burned out mass that is capable of furnishing no support to the plant. The decay is brought about in the well ventilated or aerated soils by the air loving bacteria, which convert the old roots, stems and leaves of plants, along with all other classes of organic matter available, into the sweet humus that builds up the land and furnishes food for bumper crops.

The work of the air loving bacteria of the soil is not done even after all this labor, for it is another branch of the family that makes it possible for the legumes: alfalfa, clover, vetches, peas, beans, etc., to collect from the inexhaustible supply of the air, nitrogen worth 15 cents a pound and add it to the diminishing supply of the soil. It is this class of bacteria that forms the knots or tubercles on the roots of the great soil renovating clovers. They live down in the ground collecting one of the most necessary of the plants' foods from the soil air and adding it to the best bank account the farmer has—the fertility of his land.

The soil air has yet another part to play in developing the plant. It must aid in warming the soil in the spring so that the young plants will not suffer from cold. Every warm, sunny spring day, one is reminded of the differences in temperature of the fresh air and of the ground. Later in the spring the sun's rays are absorbed by the soil, and the warm air from above the ground mingles with that below the surface and the soils are warmed ready to sprout the seeds and nurse the young plants carefully through their tenderest days.

Each and all of these agencies are responding quickly to changes and work together in the closest harmony. As the air and bacteria prepare the deeper soils, the roots follow and are brought into contact with large amounts of mineral foods which before were locked tight from them, and with moisture heretofore beyond their reach.

When the roots die after harvest, the bacteria decay them, leaving rich black humus for other roots, and also many easy channels through which the life giving air can move and make perpetual the round of change.

HOW SOILS BECOME POORLY AERATED

The ventilation that may have been originally in the virgin soil has been cut off by the closing up of the breathing spaces in a number of ways. On old lands one of the important causes is the packing of pasture land by pasturing the soil when wet. While very moist, the tiny rock particles of soil are easily moved and the small hard feet of the farm animals are just the thing to force them into the closest contact and reduce the pores to a minimum. A good illustration of this may be found by comparing the hard tenacious sod of an old pasture with the open soil of good meadow that has been pastured carefully only when dry or not at all.

Soils also become packed and tight by being plowed when too wet, in which case the action of the plow is the same as that of a brick machine used in reducing the more or less granulated particles of soil to a uniformly coherent mass suitable for pressing into building bricks. Here again the breaking down of the open soil has been through mechanical action.

Well tilled soils will be found to contain varying amounts of decayed manure, plant remains and other disintegrating organic bodies in the form of humus. This acts as a loose cementing material, building the very fine particles of soil into little grains or granules so that they may hold the soil more open and allow the free passage of air. This humus is constantly being formed and undergoing changes through the effects of the air loving bacteria, but when these die for want of air, due to the deterioration of the soil structure, the humus is soon burned out and its effects in opening up the soil overcome by the other forces at work and the soil becomes again packed and close.

It is hard to force air through a small tube filled with water and just such a condition arises in the soil when it is wet. No matter how well tilled and how open the soil may be, excess of water will close up the pores and if allowed to remain will kill the beneficial bacteria and stop their work.

Hard-pan is one of the most difficult soil conditions to deal with. The physical condition of hard-pan, and likewise of some sub-soils that function as hard-pan, is brought about by the soil grains being cemented together while in the packed condition. The cementing materials may be of various kinds,—very fine sticky clays or other materials that have at one time been dissolved in the soil water, and later precipitated as a kind of mortar that holds the soil particles in a condition at times closely approaching a layer of soft rock. These layers cut off movement of air and moisture and are so resistant that the roots of plants cannot force their way into or through them, so that food must be supplied the plants by the shallow surface soil lying above. A great part of such hard-pan and packed sub-soil is beyond the reach of plows and sub-soilers.

HOW POORLY AERATED SOILS MAY BE REGENERATED

The first thing to be looked after in opening up degenerated soils for proper ventilation is to remove permanent excesses of water or large amounts of water left temporarily on and in the soil by heavy rains.

This can be done at times by large open ditches, especially on low lands where the excess of water is due to the surface drainage from surrounding hills. The size and location of such ditches must be determined by local conditions. It may be necessary, especially on wide bottoms, to supplement such main drains by numerous lateral drains of small size. Large areas, especially those where hard-pan or tenacious sub-soils prevent any downward passage of excess moisture to lower levels where it can be held until needed for the support of crops, can be relieved by breaking through the impervious layer by some kind of very deep plowing. Still other soils lie over beds of gravel or other loose materials which make natural underground drains, but which are useless on account of a layer of impervious material which prevents the downward movement of the moisture. These soils are best treated by resorting to the method just described—very deep cultivation.

All of these methods bring about exactly the same results with regard to the ventilating and sweetening the soil; the excess water is drawn out of the pores and the air can circulate in amounts depending on the volume and size of the pores.

Once the soils are packed it becomes necessary in some way to open or increase the pores. The plow does the work for the surface few inches, but below this layer are tons of plant food of great value, and moisture which remains unused on account of the inability of the roots to live and grow in the hard soil.

Where soils are very moist, deep or sub-soil plowing is attended by a great amount of danger on account of the liability of the plow to force the soil into a still more packed condition. Humid soils are often too wet to sub-soil with a plow when the surface is too dry for cultivation.

The plowing in of organic matter, such as farmyard manure, is one of the greatest helps in the aeration of soils. For the surface few inches this is easy, but it is impossible to get manure plowed into the soil for a depth of two, three or four feet, where it will assist in the development of the roots feeding in the lower soils. Additions of humus in these lower soils can be made by inducing the roots to grow deeper. When these die off after the crop is harvested, their remains are readily converted into true humus by the bacteria in the soil. Small amounts of humus in the sub-soil, where it is ordinarily deficient, assist materially in keeping open

Plowing the Surface to a Depth of 6 to 10 inches. Sub-soiling with Plow Under Occasional Soil Conditions May Reach a Depth of About 18 to 24 inches and in good condition the part of the soil that we are trying to win back. Where legumes are used the root growth and nodules are found in greater profusion in the well broken soil.

Soils can never be worn out, but many fields are temporarily exhausted and in need of regeneration by rational methods to make them productive again.

J. H. SQUIRES,
Agronomist.

SUB-SOILING WITH DYNAMITE INSURES THOROUGH AERATION

The necessary qualities of an agency for insuring the valuable soil essentials mentioned in this Bulletin, are adaptability, efficiency and economy. For some considerable time, experimentation with dynamite has been conducted along lines which thoroughly demonstrate its ability to shatter compact masses of sub-soil. Dynamite is best adapted to sub-soiling because its forces are concentrated. A cartridge of dynamite is placed exactly in a position to accomplish a specific result—breaking into small particles an impervious mass of sub-soil. Thorough aeration of the soil results.

The efficiency of dynamite to increase the fertility of soil is proven by the fact that crops growing upon sub-soiled land are provided with deeper, richer, root-making areas. Instead of feeding upon the limited supply of plant food contained in the shallow cultivated topsoil prepared by the ordinary plow, the seed sown upon dynamited soil sends its fibrous roots into a supply of moisture and fertility varying in depth from five to six feet.

Ordinary plowing affects the soil to a depth of about six inches. The economy of dynamiting the same field to a depth of many times that reached by ordinary plowing, will be apparent to every farmer. The permanent results of sub-soiling with dynamite are of great economic value. The cost of fertilizers is reduced because of the new fertilizing ingredients available in shattered sub-soil. Soils properly sub-soiled by dynamite stand drouth better, crops mature earlier, and yield heavier than on land cultivated in the ordinary way.

The problem of supplying an abundance of moisture for the growing crops is a constant study and source of concern to all farmers. Reports of the United States Agricultural Department for August, 1911, state that that month shows the greatest decline in the condition of crops for any one month since 1901. This means that drouth has caused a loss of crops amounting to millions of dollars. It means failure instead of success for thousands and thousands of farmers everywhere.

Facing these facts, and having a quick, cheap, reliable remedy based upon scientific and logical reasons, the farmers have a remedy for drouth that can be applied rationally.

Dynamite is coming to the aid of progressive farmers who are welcoming it as a potent agency for restoring fertility, increasing crops and insuring abundant, profitable harvests.

The Du Pont Agricultural Department will gladly provide full instructions and state approximate cost of dynamiting sub-soil upon application.

Instructive booklets relating to "Tree Planting," "Farming with Dynamite" and "Sub-soiling" are sent free to all interested inquirers.

Address:

Department of Agriculture,
E. I. DU PONT DE NEMOURS POWDER CO.,
Wilmington, Del.

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Issued March, 1912

DU PONT DEPARTMENT OF AGRICULTURE

Farmer's Bulletin 2

Agricultural Promotion Work

I

A New Method of Removing Alkali from Irrigated Lands

MARCH, 1912

Prepared in the Office of
J. H. SQUIRES, M.S., Ph. D., Agronomist

DU PONT

Wilmington, Delaware
1912

THE E. I. du Pont de Nemours Powder Co. has established an Agricultural Department for carrying on practical agricultural correspondence along all lines pertaining to the improvement of land and the raising of field and orchard crops. This department will take pleasure in answering any query along agricultural lines

FARMER'S BULLETIN

A NEW METHOD OF REMOVING ALKALI FROM IRRIGATED LANDS.

An alkaline soil is one containing soluble material in an amount sufficient to retard plant growth. A large number of compounds are capable of forming alkali, but those ordinarily causing trouble are the sulphates, chlorides and carbonates of sodium, calcium and magnesium. They are formed by the breaking down of the soil particles into more easily dissolved material. In this way, alkali is being formed in all the agricultural soils regardless of the climate or rainfall.

In regions of heavy rainfall, harmful alkali is easily washed away, but in the drier regions where there is little or no drainage on account of the rain water being held by the soil and used by the plants or lost by evaporation, the alkali is allowed to accumulate and remains in part or entire.

Some of the alkali, however, is carried to lower levels by wind and by surface or sub-surface drainage following occasional rains. Where the transported alkali is left on the low lands by the wind storms or through seepage of alkaline water from ditches, canals or reservoirs, the trouble becomes more aggravated and may entirely prohibit the growing of crops.

On the higher plains of the Southwest, many alkali spots are formed by surface washing the alkali into slight depressions, where the water is lost, in part or entirely, by evaporation and the soluble salts are left in the surface soil. Along many river valleys, as in the Rio Grande and Upper Arkansas Valleys, the underlying water is very close to the surface and carries varying amounts of alkali. In places this water is being continually lifted to the surface and is lost, to a considerable extent by evaporation, leaving only the alkali on the surface. A continuation of this, of course, brings about a very destructive alkaline condition. In some of the older irrigated regions excessive irrigation on hill lands resulted in washing much alkaline material to the lower levels by means of sub-surface seepage.

There are two classes of alkali, known as "white" and "black." Of these the one causing the most severe trouble is the black alkali. The salt ordinarily causing this alkali is the carbonate of sodium, which on account of its action on the organic matter present in the soil produces a black encrustation. Ill effects are produced by smaller amounts of black than of white alkali. In treating the black form it is an excellent practice to use large amounts of calcium sulphate and bring about a chemical change resulting in the formation of calcium carbonate, a harmless substance, and sodium sulphate, a white alkali that is less harmful than the sodium carbonate. This treatment should precede removal of alkali by washing.

Many remedies, such as scraping up and carting away objectionable salts, selection of resistant crops and application of foreign materials, have been tried for the correction of alkaline soils, but the one that has proven most successful, is washing by means that approach as nearly as possible the action of heavy rains in more humid regions.

The object to be obtained in washing out alkali is to bring the salts into solution by using an excessive amount of water, and allowing it to pass entirely out of the way through sub-drainage, or forcing it downward with water percolating into the subsoil to a depth where it will not affect plant growth. When this latter method is practised it should be followed by good tillage to prevent the return of the alkali to the surface through strong capillary use of moisture.

Ordinary heavy irrigation has not proven successful unless it has been assisted by something that will allow of easier downward movement of the irrigation water, or sub-drainage.

The installation of sub-drains has been attended with many difficulties in many irrigated regions on account of absence of any suitable discharge for the drains; on account of the expense of installing drains; and on account of the regions remote from manufacturing plants being compelled to pay prohibitive prices for tile.

A more modern method is to loosen up the subsoil or underlying hardpan, that may be present, to a depth of four feet or more, depending on the nature of the underlying material, by the use of small charges of dynamite. This does not disturb the surface soil to any great extent, but opens drainage channels into the very deep material through which the wash water loaded with alkali can drain and percolate away.

An irrigation for such washing must be very heavy and should be repeated from time to time. The subsequent irrigations intended for crop growing, may follow in the usual way and if not applied in too large amounts there need be no trouble from waste of water which may be very expensive.

J. H. SQUIRES, Agronomist.

SUMMARY.

Having learned in the preceding pages that alkalis in soils are often responsible for poor crops, the reader will realize it is essential that such destroying agencies be quickly and surely removed.

The fact that alkalis can be washed away through porous soils suggests the use of an agency especially suited to make subsoils porous at the lowest cost to the farmer.

By using Du Pont Dynamite for breaking up the alkaline subsoil, we not only dispose of the injurious alkalis therein, but we put the blasted area into a condition for easier, better and cheaper cultivation.

A small quantity of Du Pont Red Cross Dynamite, even as little as one 1 1/4"x8" cartridge—about half a pound,—will generally shatter an alkaline subsoil very effectually throughout an area scarcely believable. Repeating these explosions at a proper depth and distance apart thoroughly breaks up this injurious alkaline layer of subsoil. Through this porous mass, a great number of minute channels afford a passage for the water laden with alkaline particles.

The aeration or "ventilation" of such soil follows. Air and sunshine are now of great benefit to the reclaimed subsoil. This inexpensive, and reliable drainage agency can if properly used be employed as safely as gasoline, kerosene and similar materials are used for their purposes.

Many acres now unproductive and burdensome need only a disruption of their subsoils to permit injurious, soluble alkaline deposits to escape. Every available acre should be cultivated profitably and each should produce its portion. In this manner, will the farmer receive the satisfactory profits to which he is entitled because progressive plans are employed and carried out with determination.

The Du Pont Agricultural Department will gladly provide full instructions and state approximate cost of dynamiting alkaline subsoils upon application.

Instructive booklets relating to "Tree Planting," "Farming with Dynamite," "Subsoiling," "Ditching and Draining," will be sent free to all interested inquirers.

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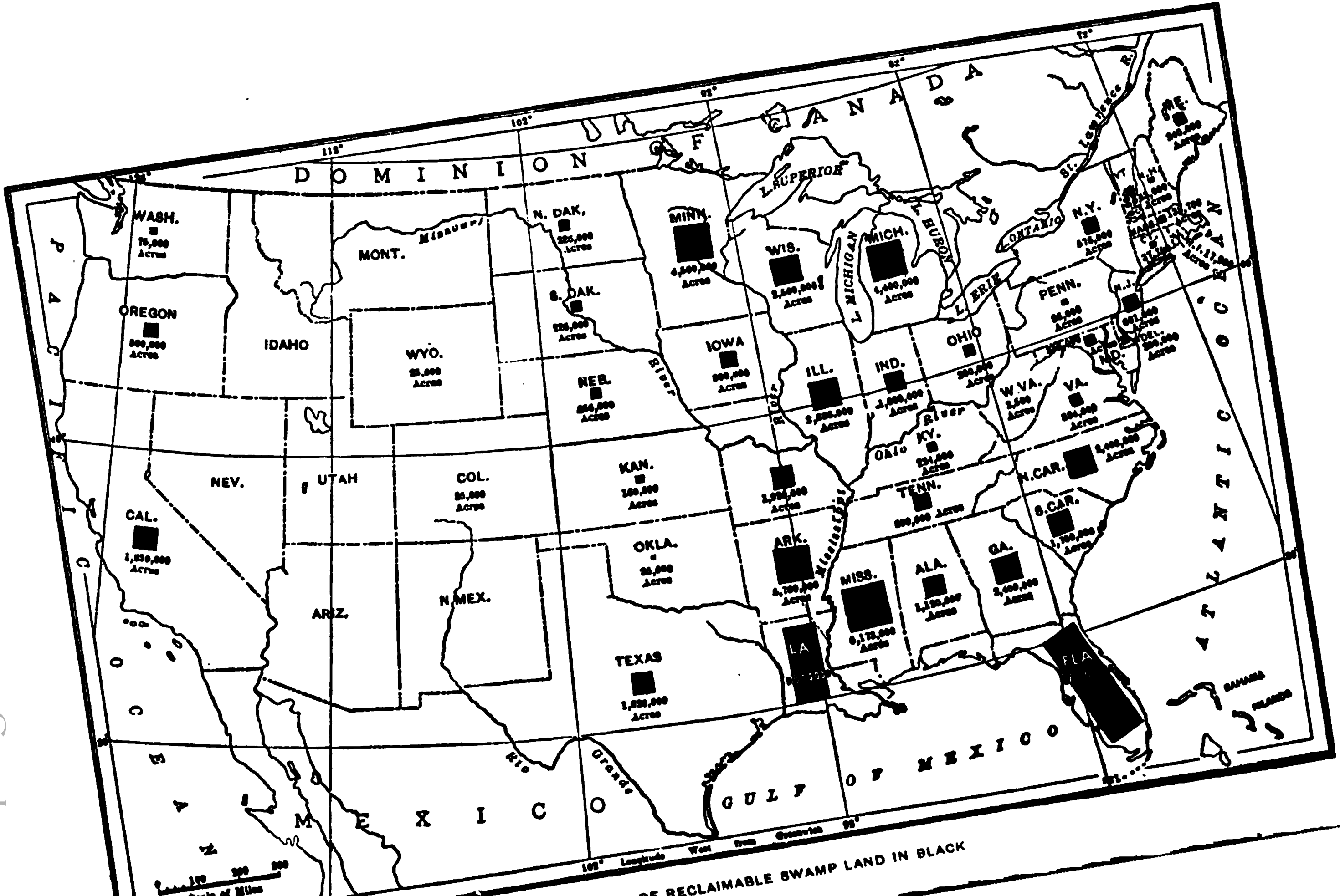


INDICATING AREA OF RECLAIMABLE SWAMP LAND IN BLACK

HIGH EXPLOSIVES—A FACTOR IN THE RECLAMATION OF WET LANDS

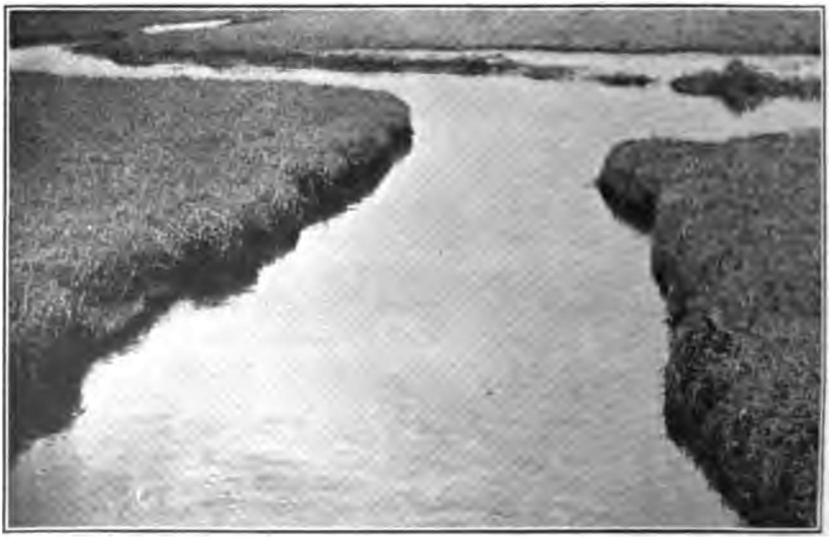
Drainage has so many objects and its importance is so far-reaching that a general discussion of the subject would require much more time than is allotted to this paper, which is intended to be more largely a discussion of methods. The great magnitude of the work can be realized only with difficulty. A recital of the extent of the great areas of swamp and overflowed lands, accompanied by a dissertation on the high value of the reclaimed lands and the profits to be obtained therefrom, makes intensely interesting subject matter, but when a careful review of the work in its detail and entirety is undertaken, a sterner aspect is presented. It is an easy matter to drain small streams even throughout their entire ramifications and to bring their excess of flood water into immediate control. The drainage of cultivated fields and the control of erosion are in most cases matters of actual doing rather than of investigation and exploitation, but a general co-ordinating of all these into one great drainage movement presents a different and far more difficult matter.

As upland drainage is increased the added amounts of water that must be handled by the streams of the next lower level are at once greatly increased and as we drop to still lower altitudes the volume of water to be handled immediately is still further increased. What this may finally result in for many general drainage districts can be told only by the actual conditions as they arise, but for others the results would at once show themselves in materially increasing the flooding of the low lands along the larger streams. So it is well to bear in mind at all times some thought of the proper balance between the different units in planning any general drainage system.

DIFFERENT TYPES OF DRAINAGE

For the sake of great ease in taking up the study of drainage methods three general divisions of the conditions may be made; the correction of streams to relieve overflow conditions, field drainage, and the drainage of natural swamp lands by gravity and levee systems.

DITCH BLASTED WITH DYNAMITE
RIDER CRANBERRY BOGS, HAMMONTON, N. J.



ANOTHER DYNAMITED DITCH ON RIDER BOGS

DRAINAGE OF OVERFLOWED LANDS

Taking these up in the order named, we have to do first, with the correction of rivers, large creeks and their tributaries. In many cases these streams were never large enough to handle the flood waters and in other cases trouble has come from the very poor handling that the streams have been given. Careless lumbering has played a very effective part in allowing drift wood, sawdust and other debris, capable of forming brush and silt dams, sandbars and other obstructions, to accumulate in the valleys. The deforestation of lands and subsequent erosion have augmented the trouble by adding more water and fine earth to the already over-burdened streams. The combined effects of these and other careless practices of man have resulted in the slowing down of the velocity of the streams; in raising the water table; and in many cases obliterating the stream channels and causing the flow, especially in flood times, to spread over the bottom lands.

For the correction of these conditions where long and exceptionally large canals are needed, nothing at present seems to offer any serious competition to the mechanical dredge, on account of its power and ability to overcome serious obstacles and to handle large volumes of earth at a reasonable cost in widening, straightening and deepening the very large streams. This method, however, has two serious limitations, especially on the smaller jobs; one is the fact that a dredge cannot dig very narrow ditches, and the other is the high cost of moving and setting up. The first prohibits its use on the small streams and the last has a similar effect on its use in short sections of large ditch.

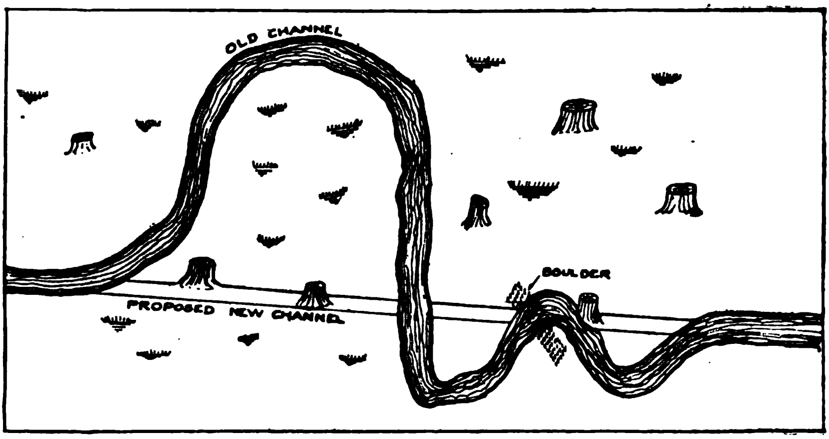
A number of large dredge propositions have been let to contractors, with prices ordinarily based on the yardage of dirt removed. These prices have varied greatly but ordinarily the charge per cubic yard of earth has been between seven and twelve cents, depending on the size of the machine used and on the total amount of work to be done. In a few instances the estimated cost of dredging has been placed at thirteen and fourteen cents per cubic yard. Sometimes this work is done by commissions in charge of the actual construction of the ditches. The machinery is bought and erected by the commission, after which the job is put in charge of superintendents. In many cases this has proven very satisfactory but so far no definite figures are available on account of factors, such as depreciation in the value of machinery, interest, etc., being hard to obtain. The cost of the construction of such outfits for steam work has been about $10,000 per dredging outfit, which of course includes the boat and the machinery.

The boats seldom if ever are narrower than 15 ft. and ditches less than 16 ft. are dug with difficulty and great risk to machinery. The depth can be governed to suit the work in hand. The greatest advantage of this method lies in the fact that the earth removed from the ditch can be used in building levees or roads without any material increase in total cost. In the reclamation of swamp lands by pumping and in the construction of highways along streams these factors become important.

In many general drainage districts the most serious drawback has been due to the fact that the dredging of medium and small streams was not practicable. Very large ditches were not needed but on account of the high cost of hand digging, large ditches were sometimes made by the use of the dredge, despite the fact that an enormous increase in the total yardage of earth to be handled was necessitated. For a long time there seemed to be no satisfactory substitute but more recent investigations have developed highly satisfactory methods.

THE USE OF SMALL DIVERSION DITCHES

In the early days of drainage, much work was done in the correction of streams by means of small hand-dug ditches intended to gradually divert the flow of water from the older channels in order to straighten the streams and thereby get a better velocity and reduce the liability of overflow. When properly located, these were of great assistance. A small amount of water was at once accommodated but later the ditch was increased in size by the accelerated flow wearing away the bottom and banks until the channel was large enough to handle the entire volume of the stream. When the location of such ditches was good, excellent results were obtained, but on account of these projects being ordinarily limited to one farm, serious troubles arose with regard to the discharge at the lower ends. Had these ditches been continued on down stream to a point where the fall was great enough to allow a good discharge in flood times, much land might have been reclaimed from the overflowed conditions without the necessity of the more costly correction after the damage has become so aggravated. At present, many developments could be perfected along these general lines but such is not advocated except in cases where great economy is necessary and the immediate needs of the bottom lands are not so great. Such conditions arise along many of the small creeks and branches in agricultural lands, especially throughout much of the Central, Southern and Eastern territory. Before the enactment of satisfactory laws for reclamation and drainage, such developments were in most cases impossible, but now, when such a development involves the drainage of more than one farm, a district can be formed and the work organized along the same lines as the larger districts.



For illustrating this type of correction I have prepared a diagram of a section of stream by combining into one short length several of the troubles found in the class of streams under consideration. A large loop is shown to represent one of the very effective causes of a slow, normal flow that results in much flooding. A rock outcrop and several stumps along the shorter and more abrupt curves are also shown. The effects of these are just the same as the effects of the larger bend,

DEEPENING CHANNEL OF A STREAM

but the methods of correction are slightly different. For relief of the conditions in the large loop an entirely new section of ditch is needed, which is shown as a straight line. This can be economically obtained by digging a medium-sized ditch that will at first carry but a small portion of the water but which will continue to wash larger, as has already been described. For the less conspicuous curves this ditch need not be in such long sections, for we can make use of large portions of the old channel if short sections of new ditch are properly placed. The rock outcrop is of the greatest importance and should be removed to the full depth of the stream desired and to a width that will accommodate any flood that may occur. The stumps of trees that may be encountered in or very near this new course should be removed in order to allow the further development of the new course to be unimpeded. After this, the normal and flood flow will keep gradually wearing away the soil and enlarging the stream, provided a little assistance is given from time to time in removing any heavy sand that cannot be lifted and carried by the water, and also all obstructions, such as driftwood and overhanging branches of trees and shrubs that would tend to cause the formation of new sand bars. The location of such diversion ditches must always be made with careful regard to accelerating the flow and must be of sufficient depth to carry a part of the flow even in times of low water.

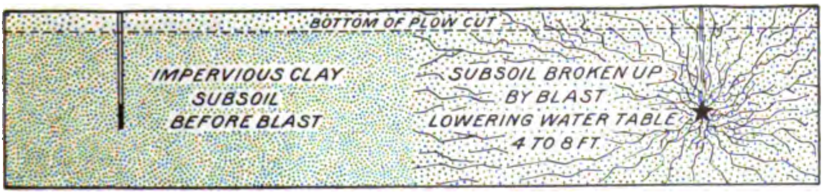
CONSTRUCTION OF SHORT SECTIONS OF DITCH

There are many cases in the larger streams where a general enlargement throughout the entire course is not necessary, but where curves or shallow stretches effectively obstruct the general flow of the stream. As such work is usually accomplished by moving comparatively small amounts of earth, the digging cannot be economically done with the heavy machine dredges and the adaptation of more economical methods becomes necessary. I will return to this subject later in a more specific discussion of ditches.

FIELD DRAINAGE

For field drainage the answer to the query of open ditch or subdrainage must be according to the need. In some bottom lands and in swamp areas, the open ditch is necessary but where practicable subdrainage should be used. All are familiar with tile-drain methods, in which clay or cement tile is placed in the bottoms of the ditches and covered up out of harm's way so that it may go on draining the land, and providing a suitable soil for the growing crops. No set rule can be made for the proper placing of lines of tile. Limited areas of lands are found where tiles may be placed 300 feet apart with assurance that the drainage will be perfect. On other soils the drainage becomes more difficult and closer spacing is necessary. I have in mind one system of well-laid tile in which the fall is good and the spacing but 25 feet where the drainage is not established after a period of two years from the laying of the tile. In another place I found a sandy loam that has assumed a hardpan condition, due to wash from limestone hills, where drains 33 feet apart were affecting strips less than 4 feet in width. In some of the heavy silt soils drains properly placed and of sufficient size do not drain more than 10 to 12 feet from the ditch. To how great an extent these conditions are present I am not now prepared to say, but the cases reported include heavy clay, sandy-loam-hardpan and incoherent silt, which are three very important and general soil types.

Many normal soils are wonderfully well-drained by substrata of open material and under many other general soil types now poorly drained we find pervious material that is cut off from the surface and rendered ineffective by impervious strata, which may vary in thickness from a very few inches to many feet. Recent experiments have proven that drainage can be established in such cases by breaking up the impervious subsoils.

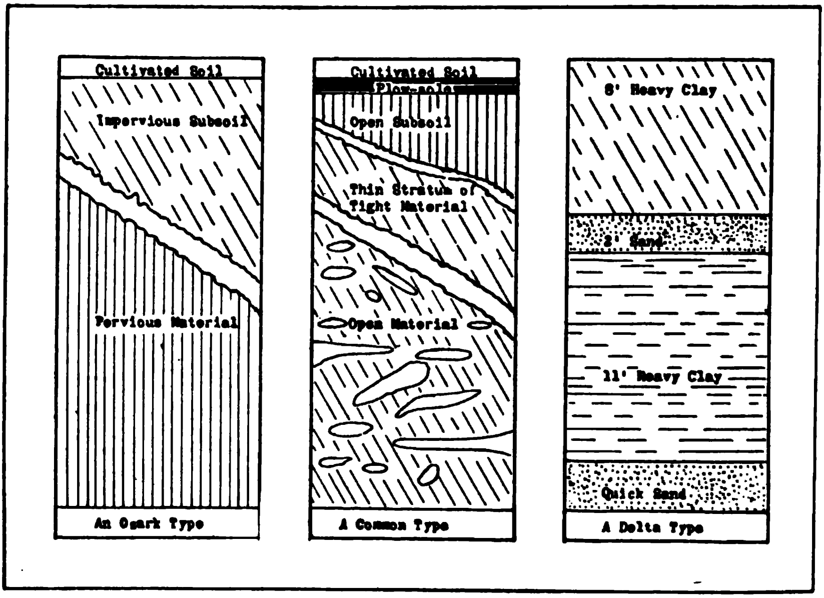

BOTTOM OF PLOW CUT
IMPERVIOUS CLAY SUBSOIL BEFORE BLAST
SUBSOIL BROKEN UP BY BLAST LOWERING WATER TABLE 4 TO 8 FT.

A good example of this was found at Columbia, Mo., where, in the corners of an old cross hedge, a depression had been formed by continual plowing of the soil away from the corners in the four fields. This resulted in the formation of a low wet spot. The subsoil to a normal distance was a heavy clay but when holes 6 feet deep were made and one pound of dynamite exploded in each, perfect drainage was at once established and the wet spot gave no further trouble.

More recently the following work was undertaken in the Mississippi delta in an effort to drain some of the very wet lands of the gumbo type of that region. A preliminary examination showed the following stratification of the soils:

Buckshot soil	8 ft.
Quicksand	2 ft.
Buckshot soil	11 ft.
Sand..........	To an unknown depth.

Carefully placed shots showed that breaking these soils down to the first stratum of sand was not effective, which indicates that this stratum was not continuous over the general area or was not connected with any general subsurface flow of water. The effort was then directed toward opening fissures into the lower stratum of quicksand and a number of holes were blasted, varying quantities of explosives were used in different kinds of the bore holes, the results of which are shown in the following tables:



EFFECTS OF DEEP BLASTING FOR DRAINAGE

Depth of holes *Feet*	Pounds of 25% Red Cross Extra Dynamite used	Results
21	1	Established immediate drainage, and continued effective through the winter rains
21	2	Same as above
21	1 + 10*	Blew a hole 6 x 8 feet and drained perfectly for 20 minutes and stopped
21	7½	Drained perfectly in the same way as the first two blasts

* One pound was used to chamber the hole for the larger amount to be shot later.

The log of the holes shows 8 feet of gumbo clay, 2 feet of sand, 11 feet of gumbo clay and an undetermined stratum of quicksand below the 21 feet of material described.

EFFECTS OF DEEP BLASTING FOR DRAINAGE

Depth of holes	Pounds of 25% Red Cross Extra Dynamite used	Results
Feet		
16	2	Established good drainage
16	1 + 10*	Blew a hole 4 x 7 feet which filled up and stopped draining
16	1 + 7½*	The surface was bulged up and good drainage was established for 10 minutes when the soil caved in and the drainage stopped
16	2	Drained well

* One pound was used for chambering the hole and the rest of the amount for the blast.

Quicksand was found at 16 feet.

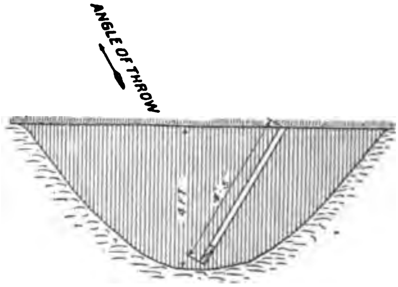
EFFECTS OF DEEP BLASTING FOR DRAINAGE

Depth of holes	Pounds of 25% Red Cross Extra Dynamite used	Results
Feet		
6	2	Drained for 20 minutes and stopped
16	2	Drained for a while and stopped
16 at 45*	15	Drained for two hours and stopped
10†	1 + 15* and ½ in outer holes	Established good drainage

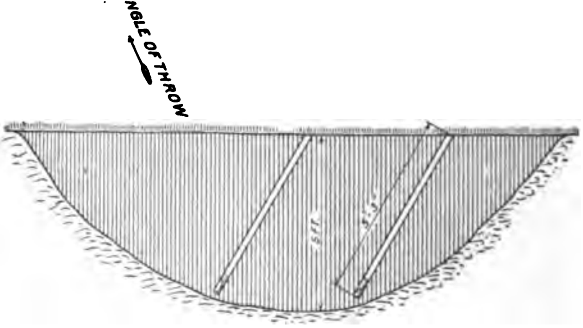
* One pound was used to chamber hole.
† Surrounded by a circle of holes 6 feet deep.

Sand encountered at 10 feet.

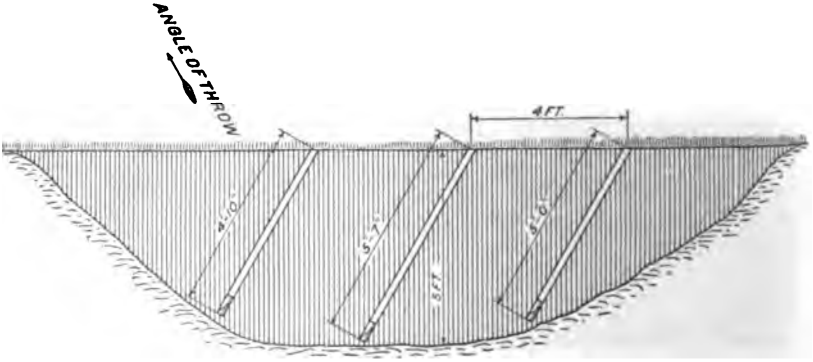
A study of these tables shows that where small amounts of 25 per cent. Dynamite were exploded in such a way that openings were made into the deeper quicksand, good drainage was established, but where large amounts were used the results were unsatisfactory. These results and those obtained elsewhere prove that for successful drainage by this method it is necessary to ascertain the nature and location of the pervious material below and to blast so that openings are made into such material.



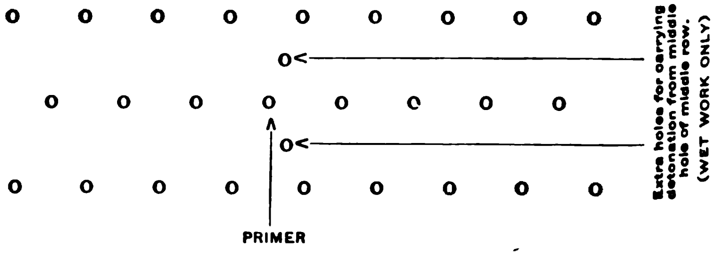
CROSS-SECTION SHOWING APPROXIMATE SIZE AND SHAPE OF DITCH EXCAVATED WITH SINGLE ROW OF CARTRIDGES



SHOWING LOCATION OF CARTRIDGES FOR WATER DITCHES USING TWO TO THREE ROWS



When there are two or three rows of holes they are sometimes alternated or staggered as follows:


PRIMER
Extra holes for carrying detonation from middle hole of middle row.
(WET WORK ONLY)

How far-reaching this type of drainage may become is as yet a matter of conjecture, but a general reading of many reports gives one a very optimistic turn of mind. In locating such shots care must be taken to guard against such efforts to drain when the actual moving water table is high enough to interfere with the establishment of good percolation. On seepy lands where the trouble is due to the underflow from higher levels being thrown to the surface by some impervious stratum the attack must be made against this impervious material. So far as we have learned, failures to establish this type of drainage have resulted, in a large percentage of cases, from faulty location of blasts rather than from a faulty method.

EFFECTS OF BADLY ERODED DISTRICTS

Closely associated with the drainage of uplands is the control of erosion, not only as it has to do with the reclamation of lands, subject to such troubles, but also with regard to the influence gullied lands have on run-off and the total flow and quick flooding of streams during heavy rains. The answer to both questions is the immediate control of the rainfall by thorough plowing and deeper subsoiling when necessary and the filling of gullies. The possibilities of work along this line and the value of lands when reclaimed have been fully established by the very exhaustive tests conducted at the Holly Springs, Mississippi, Experiment Station.

SWAMP DRAINAGE

When the question turns to one of swamp drainage the digging of ditches assumes a slightly different aspect. We have already pointed out that when there is a high rate of flow in ditches there is a large amount of work that can be done by the washing section of flowing water but some swamp districts will have a flow far too slow to achieve much in this direction, while others will have a high rate of flow if properly located. A splendid example of this can be seen at either Moyock, N. C., or Scottsburg, Ind. The North Carolina development was a typical swamp with apparently no fall but a close survey showed a fall of several feet to the mile and an excellent rate of flow developed in the completed ditch. In Indiana the trouble was a slow irregular stream, with indications of practically no fall, but when the project was completed the rate of flow was all that could be desired. In almost all cases of swamp drainage it will be best to complete ditches rather than to depend on any subsequent enlargement due to the washing out of the ditch.

COST OF DIGGING LARGE DITCHES

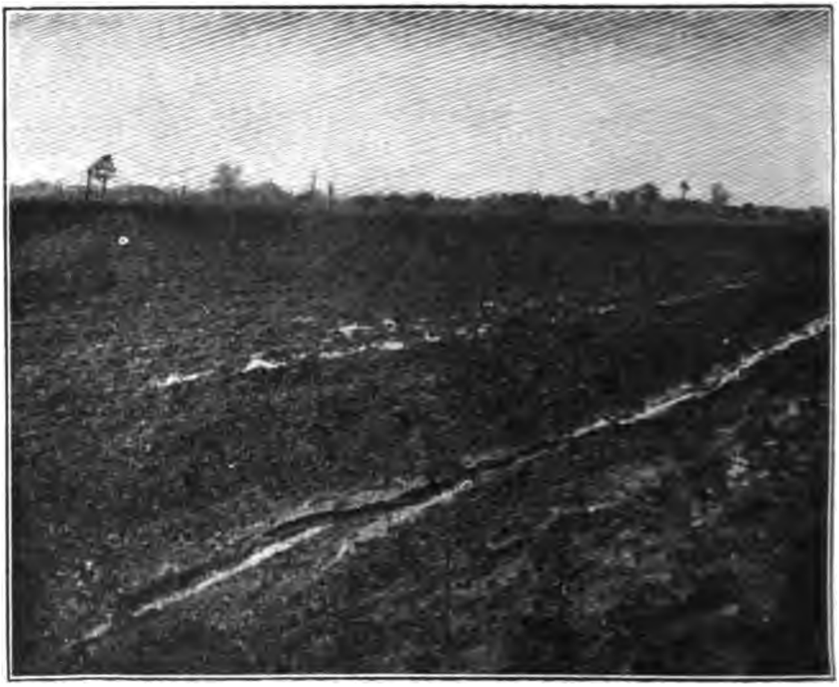
Reference has been made to the cost and size of ditches needed. For some time investigational work with the use of dynamite for the digging of ditches has been pushed. The findings have been very interesting and instructive. For blasting ditches two classes of work are recognized. One is under wet conditions, the other under dry conditions. Each calls for different methods of loading, different explosives and different methods of igniting the charges. For the wet work a straight Nitroglycerin Dynamite of 60 per cent. strength is used. The bore holes for loading this into the ground are ordinarily spaced about 18 inches apart but this spacing must be varied to suit the local soil conditions. The holes are ordinarily punched to within a very few inches of the bottom of the desired ditch by the use of a pointed bar. The first ditches were shot with vertical holes but in many cases better results are obtained when these holes are driven at an angle of from 45° to 60°. Ordinarily in such work water is found in the bottoms of the holes and the dynamite is dropped in without tamping. For small ditches one cartridge, one-half pound, is loaded into each hole. An additional primer cartridge, with cap and fuse attached, is inserted in the center hole. The shock from this one primed hole is carried through the entire line of holes, detonating all of them, which results in the entire line of loaded soil being lifted into the air and the major portion of it scattered over the adjoining fields. When deeper ditches are required, there is more earth to lift and more dynamite and deeper holes are required. The quantity of explosives may be increased by introducing more holes or preferably by loading each of the holes heavier. When a wider ditch is desired one or more additional lines of holes are punched parallel to the first lines and detonated at the same time. The distance between the lines of holes can vary from two to four feet. All holes should be put down at the same angle.

On a clay subsoil underlaid at a depth of 3 feet by a very resistant hardpan, two lines of holes 18 inches apart and 4 feet deep were made at an angle of 45°. These two lines were 4 feet apart and were fired simultaneously with one electric primer in each line, the resulting ditch was 18 feet wide and 4 feet deep at center. Two-thirds of a pound of explosive was used per foot of ditch. The estimate on yardage was 8.6c. the yard. In the same very resistant soil another double line of holes was made, in which case the spacing was 18 inches by 30 inches. The angle of the holes was again 45° and the depth 5 feet. The detonation was the same as that just described. The resulting ditch was 4½ x 12 feet in the rough and 4 x 12 feet when finished by hand.

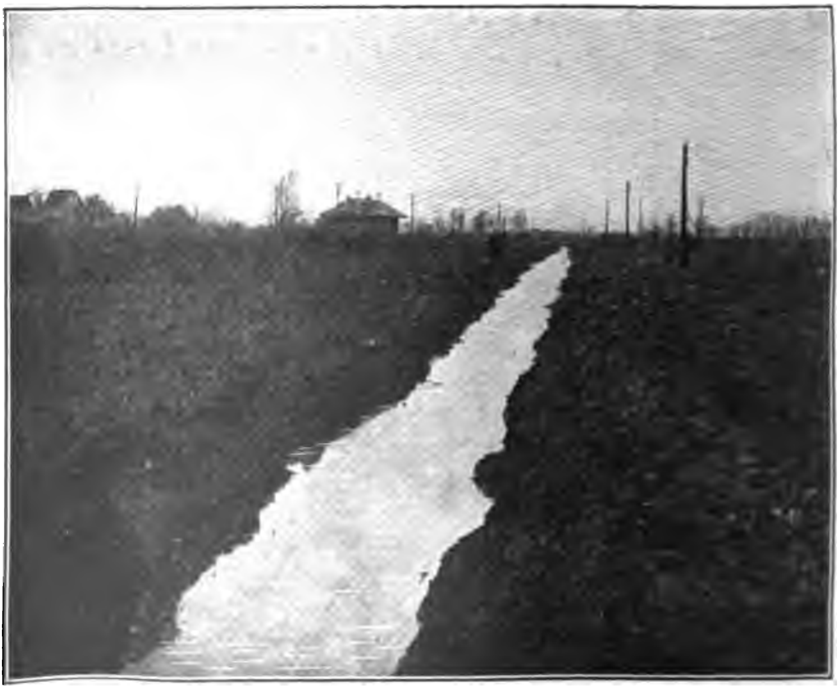
Two-thirds of a pound of explosive was used per foot of ditch. The estimated cost, including hand labor, was 10.8c. per yard. These shots were not tamped in any case, the explosive being confined by the water column in the hole.

AFTER A BIG DITCH BLAST AT DIEHLSTADT, MO.

In this illustration we have a view of a fresh blasted ditch. I regret that no pictures of the ditches under consideration are available, but this one is characteristic and illustrates the character of ditch before being dressed up by hand. You can see that unless a very neat ditch is desired, no work is necessary after the blast and many ditches receive no such treatment. These ditches were shot in short lengths on an experimental scale, so that all labor of cleaning necessary to bring the ditches up to the standard specified was with shovels. On longer ditches, or where the work is undertaken commercially, this small amount of cleaning can be done in a much more economical way by use of an ordinary slip scraper drawn by light horses or mules. When this kind of ditching is undertaken the actual labor can be performed by those benefited, thereby making a great reduction in the actual cash cost of ditch. The only expense would be for explosives and no heavy machinery would be required.



DITCH BLASTED WITH DYNAMITE AT LOUISVILLE, KY.
NOTE WASHING BEGUN IN BOTTOM OF DITCH



SAME DITCH AS ABOVE FILLED WITH WATER

Further tests in which the comparative cost per yard and per linear foot remained about the same as in those first quoted were made. A ditch 6 feet deep and 10 feet wide was made at a cost of 10.5c. per cubic yard of earth removed. Another one 6 feet deep and 10 feet wide cost 10.5c. per cubic yard and another 5 feet deep and 10 feet wide cost 9.6c. per cubic yard of earth. All of these ditches, as before stated, were dug in soils that offered great resistance to the explosives. A good location was then selected and a double line of holes 34 inches apart longitudinally and 4 feet laterally were bored at an angle of 45°. The first line was loaded with one pound of dynamite to the hole and the second with one-half pound. A good ditch 6 feet deep and 16 feet wide was blown, which was not given a hand finish. Many similar ditches are being continually reported.

At Diehlstadt, Mo., a large ditch was shot by using three lines of holes spaced 3 feet each way. The center holes were 3 feet 8 inches in depth and were loaded with 1½ pounds of 50 per cent. Dynamite and the outside holes were 3 feet deep and were loaded with one pound of the same goods. There was 1 foot of water in most of the holes and no tamping was done. On account of the strip of dry sandy material in the middle of the ditch the detonation did not carry through the entire length of ditch from the first primer but subsequent primers set the other sections off. The result of these shots was a ditch 1720

THE DIEHLSTADT, MO., DITCH FILLED

BEFORE THE BLAST, BURKETT FARM, NEWBURGH, N. Y.

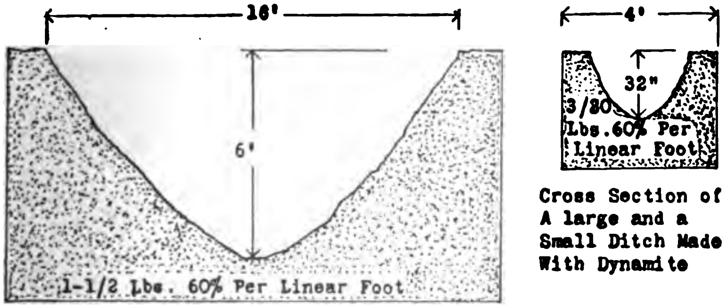
THE BLAST

A FEW MINUTES AFTER THE BLAST

feet long, 16 feet wide at the top, 8 feet wide at the bottom and 4 feet deep with occasional strips of decidedly deeper ditch. There were 3058 yards of earth removed at a total cost of $329.00, or $0.1075 per cubic yard. This reduced to linear feet gives a cost of 19.1c. per foot of ditch. These figures take into consideration the cost of labor as well as the cost of explosives. It should be borne in mind that such short lengths of ditch cannot be economically dug by a floating dredge and that other methods would materially increase the cost.

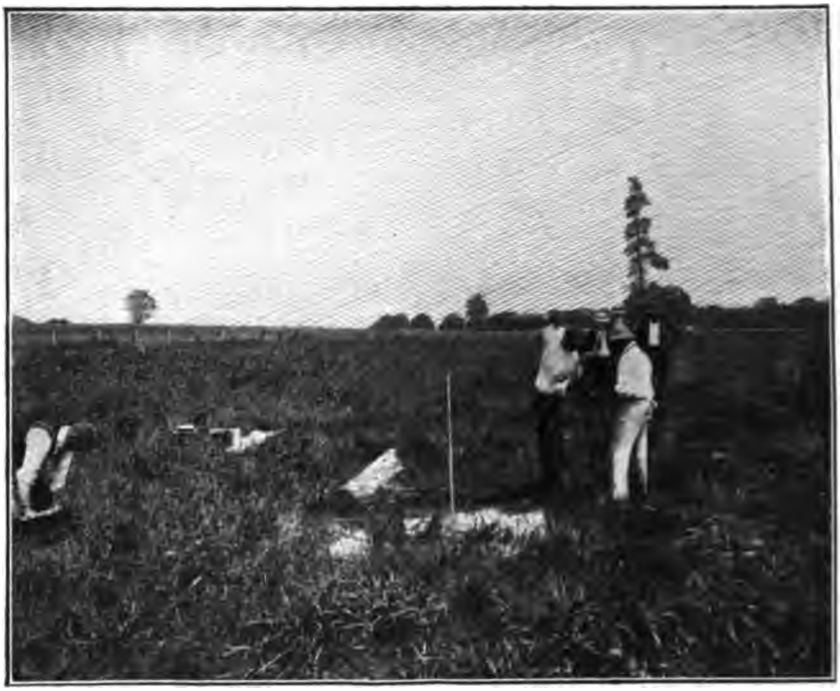
COST OF DIGGING SMALL DITCHES

In digging smaller ditches the actual data are fully as conclusive as those for large ditches. For a field ditch holes were spaced 20 inches apart and were driven at an angle of 45° to a depth of 32 inches and loaded with one-half cartridge, one-quarter pound of 60 per cent. Nitroglycerin Dynamite. This resulted in a good ditch 32 inches deep and 4 feet wide. The dirt was all wasted to one side. Continuing the test a similar trial shot was made using the same loading but with better tamping. The ditch made was 3 feet deep and 4½ feet wide. Another trial shot gave similar results. Reducing these figures to the linear foot basis, we get a cost of 1½c. per running foot of ditch for dynamite and a practically negligible cost for labor. We see then that the digging of open ditches in wet work for gravity and pumping systems can be done in a very satisfactory manner by use of explosives.



Cross Section of A large and a Small Ditch Made With Dynamite

CROSS-SECTIONS OF BLASTED DITCHES, SHOWING COSTS OF EXCAVATION



PLACING CHARGE FOR DRAINING POND AT NEWARK, DEL.

A FEW MINUTES AFTER THE BLAST OF POND

DIGGING DITCHES IN DRY SOIL

For blasting ditches through dry soils a slight modification is necessary on account of the difference in resistance. Dry earth possesses a greater power to absorb shock and prevents one cartridge being able to detonate a second one loaded in an adjoining bore hole. As there is no water in the dry bore holes it becomes necessary to tamp them after loading. The selection of dynamite is also different, as a less expensive explosive will do the work. Here the 60 per cent. Nitroglycerin Dynamite can be replaced by a 40 per cent. grade of Extra Dynamite, which materially reduces the cost per pound of explosives. The detonation in this work is by electricity—a fuze being placed in each hole. The wires are then connected with a blasting machine so that the entire section can be shot simultaneously. In this class of work the holes can be spaced further apart, as there is no necessity of the detonation carrying through.

At Heidelberg, Pa., a demonstration ditch 40 feet in length was blasted by using 3-foot holes spaced 24 inches apart each way. The loading was with one pound of Dynamite. A good ditch 4½ feet deep and 5 feet wide was made.

At Kratz, Pa., on a dry soil, holes were drilled to a depth of 28 inches and placed 20 inches apart and loaded with one-half pound dynamite to the hole. A good ditch 5 feet wide was made.

Other tests brought out the same results and further tests will develop more satisfactory methods for this type of shooting that is so important in draining overflowed lands where entirely new courses are necessary.

GREATER POSSIBILITIES

A general review of the ditching results shows that High Explosives can be successfully used in digging large and small ditches in dry soils and in wet or marshy lands. The maximum depth of ditch reported was 6 feet and the maximum width 18 feet. Wider ditches can be shot successfully and it seems now that very careful experimentation will reveal the fact that deeper ditches can be blasted in a highly successful manner. In this method very short as well as long ditches of any size can be constructed at a very low cost per cubic yard of earth removed or per yard of ditch. For the construction of ditches of intermediate size excessive cost of hand labor is avoided, as is the necessity of the removal of additional amounts of earth by the large dredges.

DYNAMITING DIGS DITCHES THROUGH LAND THAT CANNOT BE ECONOMICALLY HANDLED OTHERWISE

A DITCH BLASTED AROUND A CORNER IN ONE BLAST

When bad water conditions are met with, such as a total inundation of the area to be drained, blasted ditches should be begun from the lower end in order to allow the work to be done under better soil conditions, which are brought about by drainage being established from the very beginning of the work.

THE TIME ELEMENT

Aside from the actual construction of canals, attention should be given to the time required for the completion of a drainage system. When draining is being done for sanitary purposes, or to meet the immediate agricultural demands, the matter of hastening completion is of the greatest importance. The different methods require varying amounts of time. The time required for hand labor depends absolutely on the number of laborers available. Dredge work progresses steadily but slowly. Ditches can be dug with dynamite in a wonderfully short time.

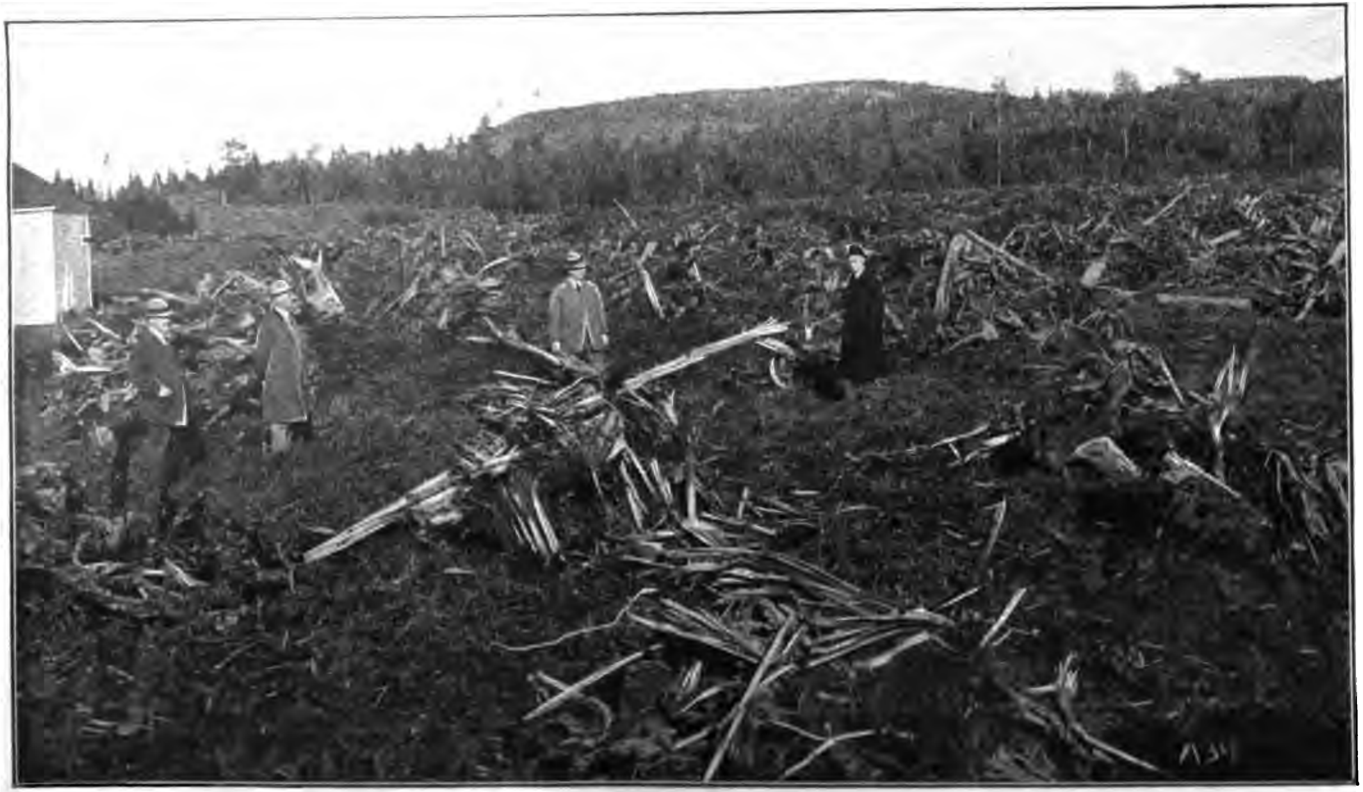
CLEARING DRAINED LANDS

In the reclamation of land by drainage the cost per acre for the construction of main canals would remain comparatively small, but it will be found that the cost of removing the stumps will be far greater than that of the drainage itself. Almost all of the swamp land is heavily forested with pine, gum, cypress and other forest trees, and a large portion of the overflowed land carries more or less timber. In order to bring about anything like satisfactory type of agriculture, the stumps must be removed—not by time, but by mechanical agencies.

In stumping three things must be taken into consideration: The character of the stump, whether large or small, tap or fibrous rooted, and whether dead or green; the character of the soil, whether wet or dry, light or heavy; and the disposal of stumps after their removal. All of these factors are very important, no matter what method of removal is employed.

METHODS OF STUMPING

Some of the chief methods of stumping employed at present are Pulling with Horse-Power, machines or donkey engines, grubbing, burning and blasting. Sometimes a combination of two methods is used. The burning methods have not, with one exception which I will point out later, been satisfactory in the removal of stumps under the conditions confronted in reclamation by drainage, for no amount of coaxing with fire can economically remove green stumps from these wet lands.



A WELL CLEARED FIELD ON FARM OF G. G. HARTLEY, HIBBING, MINN.—THIS STUMP COVERED SWAMP, TEN MONTHS AFTER CLEARING WITH DYNAMITE, YIELDED $800 WORTH OF CELERY PER ACRE

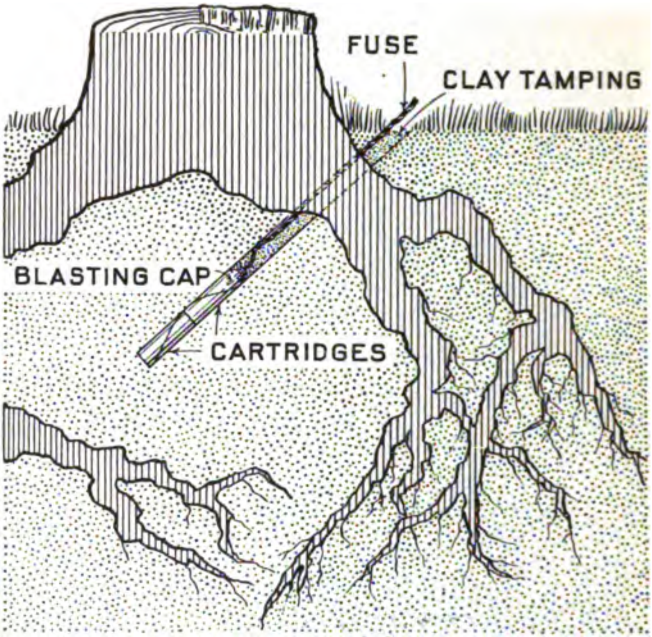
SHATTERING AND BURNING

The fat pine stumps have become of considerable commercial importance, in that they can be made to yield large quantities of distillates of value. Large numbers of stumps are thus yielding landowners a profit, so that much more attention should be given this particular branch of work when planning extensive reclamation projects in regions where such stumps are found. If on account of isolation or small areas of stumps the marketing cannot be done profitably, the problem of most economical removing becomes paramount. In some cases complete immediate removal is desirable; in others, shattering and burning is more satisfactory.

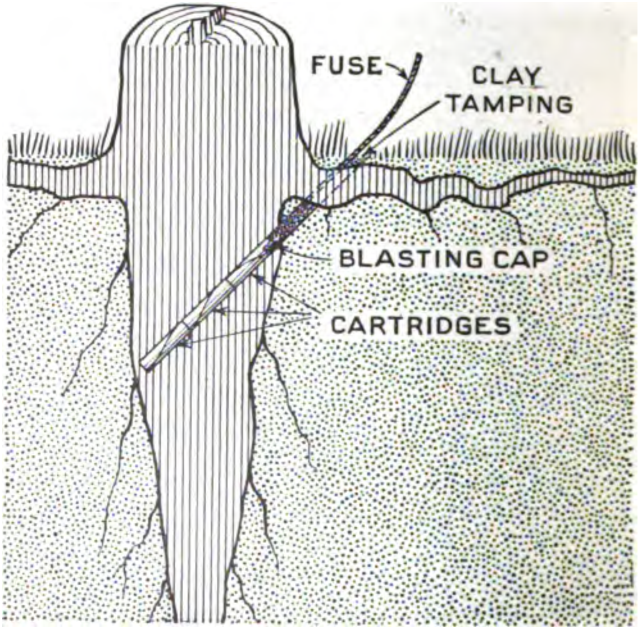
For this purpose a very small charge of about 1/6 to ¼ of a pound of 40 per cent. Extra Dynamite is inserted into the root of the stump just below the surface of the ground. Where very large stumps are encountered, the charges must of course be increased. The blast will shatter the wood and prepare it for rapid burning, which should destroy the stump to a depth sufficiently great to allow good cultivation, provided the land is well drained. Dead stumps naturally burn much better than green ones.

PULLING AND BLASTING

For the removal of stumps from wet lands, there are but two methods that are not used under serious difficulties. These are, pulling by the use of the donkey engine and blasting. The use of horse pullers is prohibited by the soft mud giving poor footing for the horses and the excess of water keeps the stumps too wet for satisfactory burning. Under such conditions the soils are naturally very open and the stumps



FUSE
CLAY TAMPING
BLASTING CAP
CARTRIDGES



FUSE
CLAY
TAMPING
BLASTING CAP
CARTRIDGES

are lifted with a minimum effort. When the excess of water is too great, some of it should be removed by drainage in order to permit a more economical use of labor. This is important in cypress swamps on account of the difficulty of locating the roots under water. I regret very much not being able to give you comparative figures on the costs of the different methods, but such data are very difficult to obtain.

BLASTING PINE STUMPS

You realize that the pine is a tap-rooted tree, and that in many cases the roots are actually larger at or immediately below the ground than they are above. The method of loading for the complete removal of such stumps does not differ materially from the loading to shatter them for burning, except that the hole is bored into the tap root at a greater depth and a larger amount of dynamite is used. For an economical use of explosives the bore hole for loading should extend well into the root at the depth to which you desire to remove the stump, in order to get a considerable portion of the charge within the wood itself. This method of loading gets the maximum effect of explosive and while slightly increasing the labor cost proves more economical on account of the saving of explosives. The actual cost of removing pine stumps with dynamite is shown in the following table, which was compiled from the results obtained in various parts of the country:

COST OF EXPLOSIVES FOR BLASTING PINE STUMPS

Number of stumps	Variety of pine	Average diameter	Cost of all blasting supplies at consumers' prices
		Inches	
354	?	28.7	$0.35
86	Long leaf	29.6	.317
18	Short leaf	38	.44
310	Yellow	28.9	.235
7	Jack	14.8	.215
21	Norway	40.4	.754
184	White	44.2	.722
7	Yellow	39.4	.34

These are the most complete data now at hand, but the costs are somewhat higher than would be found in actual practice. The stumps were blasted at advertising demonstrations where the men in charge often overloaded to a considerable extent in order to avoid all possibilities of failures, which at times bring down a storm of ridicule on those doing the work. The cost of the blasting supplies was computed on consumers' prices.

An exhaustive test was made of the use of four different grades of dynamite for blasting pine stumps. The results of this are reported in the next table in which the costs are based on carload lots in order to bring out just what can be accomplished when stumping is undertaken on an extensive scale:

COST OF BLASTING PINE STUMPS WITH DIFFERENT GRADES OF DYNAMITE—COSTS BASED ON CARLOAD LOTS

Kind of dynamite	Average diameter of stumps	Average cost per stump
	Inches	
Red Cross Extra 33%	24	$0.15208
" " " 40%	23½	.115
" " " 60%	27	.1765
Hercules No. 1, 60%	32⅗	.26255
Total number of stumps blasted—162.		

The discrepancies in the average diameters of the stumps blasted with the different grades of 60 per cent. Dynamite prohibited any absolute comparison between the effects of Hercules and the Red Cross Extra. But the cross comparisons of tests with the Red Cross grades show conclusively that the 40 per cent. is the best selection for such work. In all cases the costs are exceedingly low and demonstrate that a careful use of a well-selected explosive results in the removal of stumps at an exceptionally small cost.

BLASTING FIBROUS-ROOTED STUMPS

The blasting of oak and similar fibrous-rooted stumps calls for slight modifications in loading. When no tap root is encountered the loading is done under the heaviest part of the small stumps, and under the big roots of the larger stumps. When large stumps have several roots under which charges are needed, it becomes necessary to blast electrically. I will not tire you by going into details in regard to the actual cost of blasting such stumps but will simply call your attention to the following short table which shows about the same cost for a given size of stump that we have found in the other tables:

COST OF BLASTING FIBROUS ROOTED STUMPS

Kind of stump	Number of stumps	Average diameter	Cost of explosives. Consumers' prices
		Inches	
Chestnut	8	20.6	$0.21
Elm	1	73	1.52
White Oak	20	34	.42
Ash	2	54	.63
? Oak	6	28	.37
Birch	10	24	.33
Gum	2	21	.32
Walnut	3	34	.51

It must be remembered that these figures are for all the stumps of the variety named that were blasted within a given time, and that no omissions or selections were made. Numerous other classes of trees were reported but the study would become too long with these added.

BLASTING CYPRESS STUMPS

For blasting cypress roots and stumps, additional precautions must be taken. The first work was undertaken under very wet conditions and water-resisting explosives of high power were used. Recent tests bring out the fact that for such clearing it is best to first remove all excessive amounts of water by drainage, and then while the soils are still moist locate the principal branches of the great tangle of below ground parts and load under these with 40 per cent. Extra Dynamite and shoot out entire sections by electric blasting without attempting to remove individual stumps with single shots. They can, however, be blasted from undrained swamps in a highly satisfactory manner.

THE DISPOSAL OF STUMPS

The disposal of stumps is an important proposition. When they are useful for distillation it is well to use some method of removal which will bring them out clean of dirt and possibly shattered in preference to an equally economical method in other respects, that is imperfect in either of these details. When stumps are to be burned on the ground or used for fuel, shattering, splitting, or even cracking them in their removal is decidedly beneficial. Large stumps lifted out entire are very difficult to handle, and the burning of such is an almost endless task.

It is not the intention of this paper to try to establish any false idea that dynamite is a panacea for all drainage ills, and an effort has been made to avoid all invidious comparisons, but I do trust that the facts presented will call to your attention some of the possibilities attending the rational use of high explosives in the reclamation of wet lands..

J. H. SQUIRES, Agronomist.

110 FEET DITCH BLAST

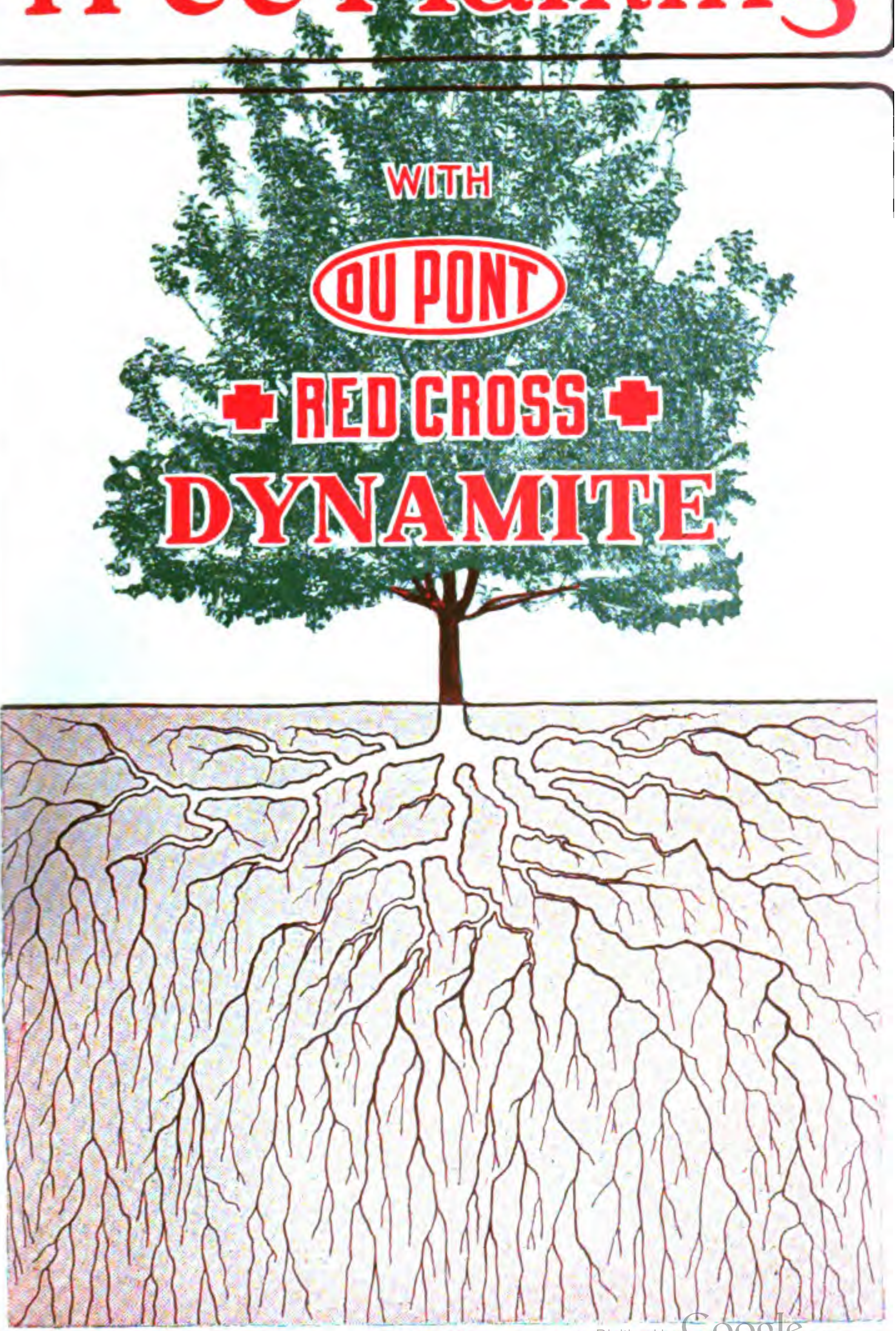
Tree Planting

WITH

DU PONT

RED CROSS

DYNAMITE



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◆ ◆ ◆

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THE LORD BALTIMORE PRESS, BALTIMORE, MD.

TREE PLANTING WITH DYNAMITE

A Revolution in Orcharding

The greatest development in agriculture since the invention of the mower and reaper is the use of dynamite in farming.

The stump-blaster was followed by the tree-planter, who planted fruit trees in the depressions made by the dynamite explosions, partly as a matter of convenience and partly because it seemed logical to assume that the same soil which had been good for forest trees would be good for fruit trees.

This practice led to the discovery that fruit trees set in dynamited holes developed much more rapidly than those set in spaded holes. They lived through drouths when others died. They came into bearing one to two years earlier than spade-set trees. They produced more and better fruit. Today the leading orchardists and nurserymen all use dynamite both for planting new trees and cultivating old ones.

Dynamite has almost entirely eliminated the gambling chances of orcharding. Even the frost-resisting qualities of dynamite-set trees are greater than those of spade-set trees.

In 1911 millions of fruit and nut trees were planted with dynamite.

In 1912 the number will probably be doubled or trebled.

In addition, the many millions of fruit and nut trees spade-set one to twenty years ago, may be forwarded in development or regenerated by dynamite.

Thus we are passing through an epoch of revolution in orcharding that means much to both grower and public.

It behooves every orchardist and nurseryman who is alive to his interests to learn at once how dynamite is used in the orchard, and what it means in dollars to him.

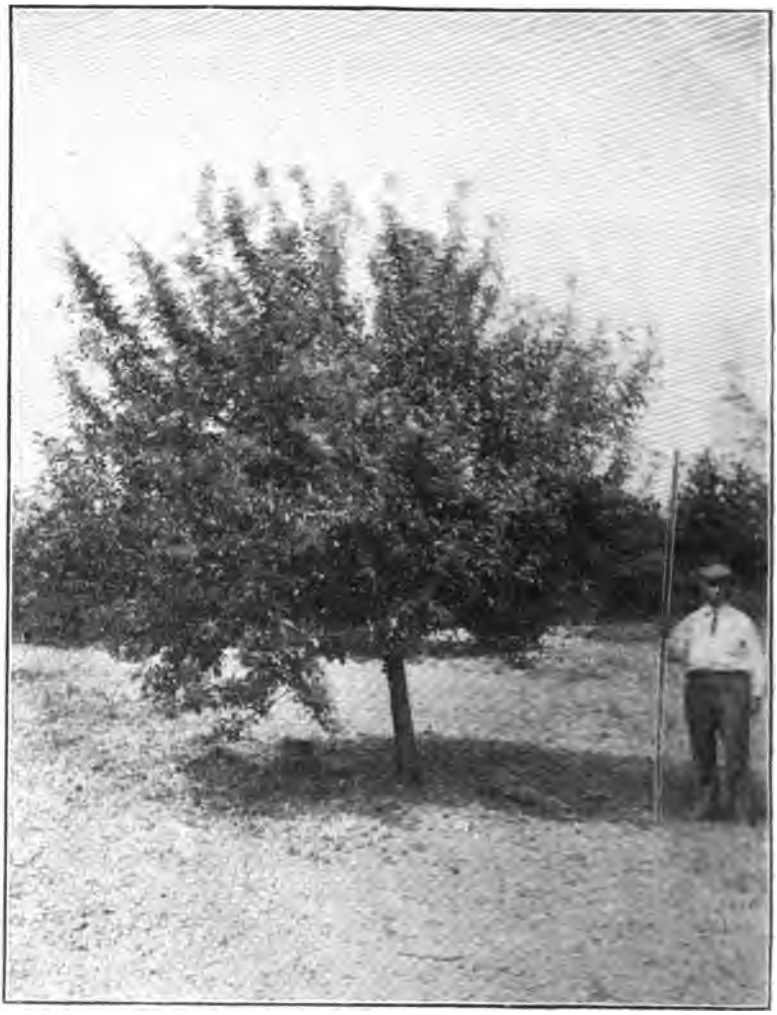


FIGURE 1

Five-year-old apple tree planted where old apple tree died of fungus growth and was blasted out. See Craig method, page 15. Man is holding 8-foot pole.

Proved Results from the Use of Dynamite:

1. More Economical Than Any Other Method Because—
    - (a) The actual cost of planting is little if any greater than with spade.
    - (b) Dynamiting almost entirely prevents the big first year loss common to spade-set trees.
2. More Productive Than Any Other Method Because—
    - (a) Dynamite-set trees bear marketable fruit one to two years sooner than spade-set trees.
    - (b) The quantity of fruit is greater than on spade-set trees.
    - (c) The quality and color of fruit is better.

Proved Results from Use of Dynamite in Cultivating and Regenerating Orchards:

1. Young spade-set trees can be forwarded in development at least a year by dynamite blasting between the rows.
2. Old, failing trees can be restored to ample productiveness by blasting between the rows.
3. Fungus disease can be eliminated by blasting under affected trees, or blowing out those killed by fungus, and planting new trees in their places.

All the foregoing results are obtainable with grape vines, nut trees, fruit-bearing bushes and flower or fruit plants.

The logic, records of experience, illustrations, and diagrams that follow, prove all the foregoing claims.

Every orchardist, nut-grower, vinyardist, gardener or florist is urged to read every word of this booklet. If you belong in any of these classifications, this book is the most important document ever put before you. Every day's delay in learning and putting into effect the methods here advocated may mean a large loss to you.

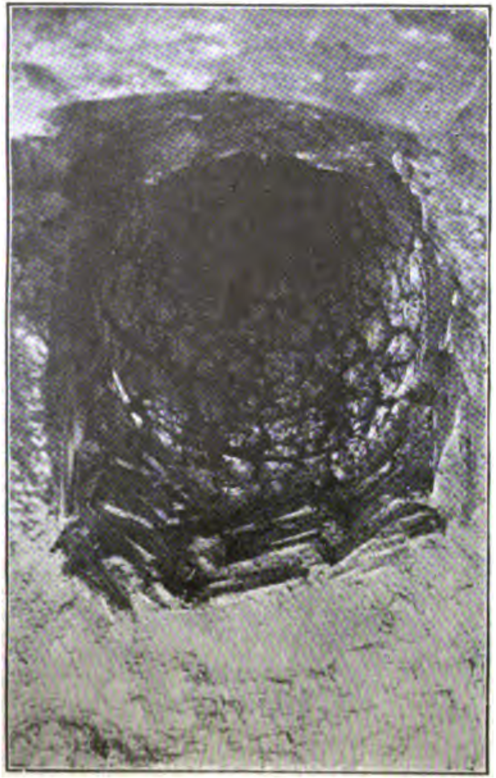


FIGURE 2
Top of Hole Blasted for Planting Fruit Tree
(Note radial fissures)

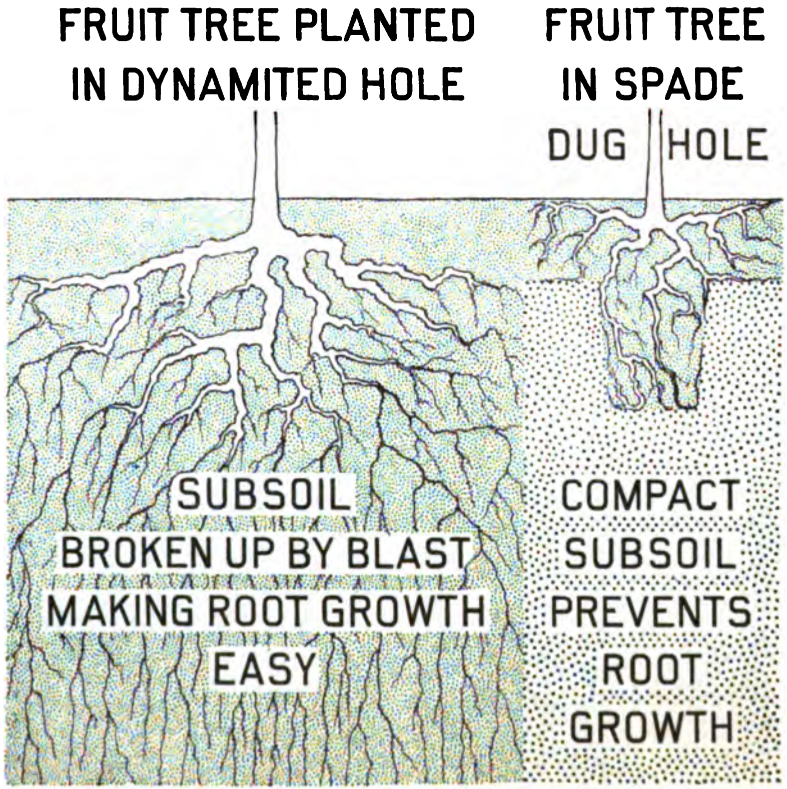

FRUIT TREE PLANTED IN DYNAMITED HOLE
FRUIT TREE IN SPADE DUG HOLE
SUBSOIL BROKEN UP BY BLAST MAKING ROOT GROWTH EASY
COMPACT SUBSOIL PREVENTS ROOT GROWTH

FIGURE 3
Diagram of Soil Section

The Principles of Plant Growth

It has been conclusively proven that dynamite is an exceedingly valuable aid in the successful growing of trees. Those who have tried it are thoroughly convinced that no method of excavating the hole in which to plant a young tree is so economical, quick, or productive of desirable after-results as blasting with dynamite. We use the word "economical" in the sense described in our article regarding costs on page 9.

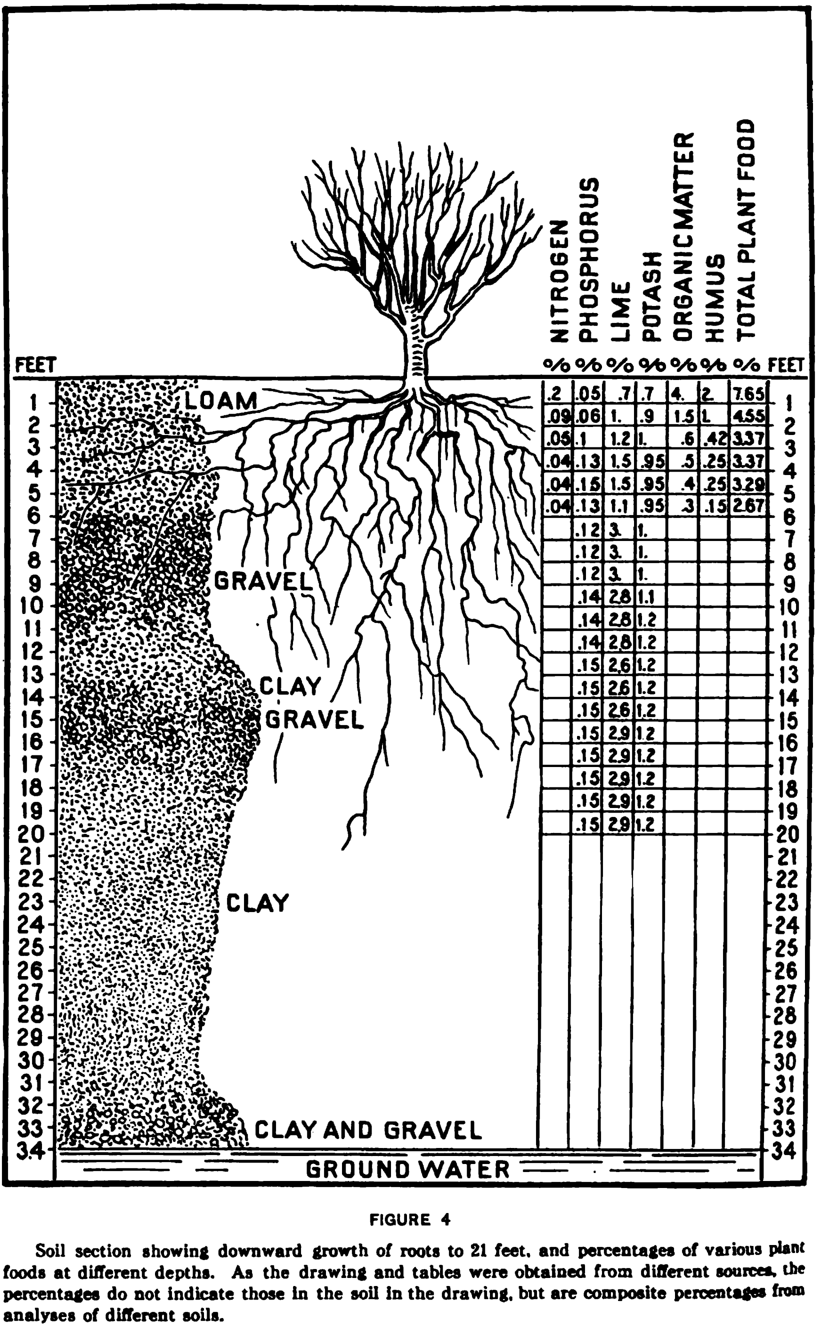
Sometime ago it was the prevailing idea that dynamite was unnecessary for tree planting unless the soil chanced to be underlaid with hardpan, in which case the explosive was regarded as valuable for breaking up the hard soil. It has been found by experiment, however, that trees thrive better when planted in blasted holes than in hand-dug holes if there is underlying hardpan, or clay, clay loam or silty loams that are liable to become hard or impervious.

The explanation of this is simple. It is because the explosion of the dynamite loosens up the soil for yards around the spot, and thus makes root growth easy; whereas, digging the hole with tools tends to pack the earth around the sides and at the bottom of the hole and retard root growth.

Scientific agriculturists have discovered that water is the most important element in all kinds of plant growth. It forms a major portion of the green weight of the roots, trunk, branches, twigs, leaves and fruit of the plant. The proportion of moisture will, of course, vary in the different parts. The roots will be found to contain more moisture than the trunk, and the branches, twigs and fruit a larger percentage than the hard wood parts.

Water or soil moisture is the carrier of the tree's plant food. It also influences the temperature of the plant. In dry hot weather the evaporation of large amounts of water from the leaves of a tree has a slightly refrigerating action. It requires more heat units to raise a given weight of water one degree in temperature than it requires to cause a similar increase in the weight of wood or stone. This is effective in saving trees from immediate harm due to quick changes of temperature. Moisture also has the effect of maintaining the stiffness of the more succulent parts of the plant. A good illustration of this is the noticeable withering of corn and other plant leaves when the supply of moisture is insufficient. Lack of moisture is just as effective in retarding the development of leaves of trees, but it is not so noticeable. Soil which is of the natural consistency to allow water to circulate freely through it and still retain or conserve it so that it is available at all times for growing plants, may be considered as ideal for agricultural purposes. Few soils possess this natural consistency. Other soils, which may be classified as good, average, or fair, must have artificial preparation in order to make them produce the results that may be expected from the rarely-found perfect natural soil.

Few persons understand the principle of plant growth. It is not necessary, as many suppose, that the root of a plant shall come in actual contact with all of the plant food elements of the soil needed for the sustenance of the plant or tree. Plant roots have the power to draw from the surrounding soil the necessary elements of plant food, provided the soil is of such a character as to permit the passage of these elements through it. Water or moisture is the carrier of these plant-food elements through the soil and into the



NITROGEN %	PHOSPHORUS %	LIME %	POTASH %	ORGANIC MATTER %	HUMUS %	TOTAL PLANT FOOD %	FEET
.2	.05	.7	.7	4.	2.	7.65	1
.09	.06	1.	.9	1.5	1.	4.55	2
.05	.1	1.2	1.	.6	.42	3.37	3
.04	.13	1.5	.95	.5	.25	3.37	4
.04	.15	1.5	.95	.4	.25	3.29	5
.04	.13	1.1	.95	.3	.15	2.67	6
	.12	3.	1.				7
	.12	3.	1.				8
	.12	3.	1.				9
	.14	2.8	1.1				10
	.14	2.8	1.2				11
	.14	2.8	1.2				12
	.15	2.6	1.2				13
	.15	2.6	1.2				14
	.15	2.6	1.2				15
	.15	2.9	1.2				16
	.15	2.9	1.2				17
	.15	2.9	1.2				18
	.15	2.9	1.2				19
	.15	2.9	1.2				20

FIGURE 4

Soil section showing downward growth of roots to 21 feet, and percentages of various plant foods at different depths. As the drawing and tables were obtained from different sources, the percentages do not indicate those in the soil in the drawing, but are composite percentages from analyses of different soils.

plant roots. This will indicate the importance of a porous soil which will permit the free passage of water through it in order that plants growing upon the surface may be properly nurtured for rapid and healthy growth.

This, together with the fact that the action of an explosive on soil causes it to become thoroughly mellowed and aerated, causes trees planted in blasted holes to show much stronger and healthier growth than trees planted under old conditions.

In order to give those who may not understand the subject an idea of the scientific principles of plant growth, we will quote Mr. W. J. Spillman, Agriculturist in charge of Farm Management Investigations, Bureau of Plant Industries, U. S. Department of Agriculture. He says in a recent bulletin:

"Plant food is dissolved in water. While a plant is growing, a constant stream of water flows up through it and evaporates at its leaves. For every pound of increase in dry matter made by the plant, from 300 to 500 pounds of water flow up through it.

"Plants in their growth make use of thirteen elements, nine of which they secure directly from the soil. These are called the mineral plant foods. They are phosphorus, potassium, calcium, magnesium, sodium, iron, silica, chlorin and sulphur. Soil consists mainly of small particles of rock. Nearly all kinds contain more or less of these mineral plant foods. Every year the soil water dissolves off a thin surface layer from each particle and plants appropriate this water, thus securing their mineral plant food. Hydrogen, another important element of plant food, is also secured from water.

"In order to produce a ton of hay on an acre of land, it is necessary that the growing grass pump up from that ground approximately 500 tons of water. In order to supply this enormous quantity of water, the soil must not only be in a condition to absorb and hold water well, but must be porous enough to permit water to flow freely through it.

" In addition to acting as a water carrier for plant life, soil must permit a proper circulation of air through it. Nearly half of the volume of ordinary soils is occupied by air spaces. Soil which becomes so compact as to stop the air passages, is too wet for most crops and needs drainage, for plant roots must be supplied with air and the soil must be porous enough to permit of its free circulation.. One of the most important objects of plowing is to loosen up the soil and mix fresh air with it."

Orchardists and nurserymen who have had long experience in planting trees in holes prepared by dynamite blasts, have learned that compact subsoil is broken up by the blasts, which enable the land, thus made porous, to absorb plenty of water in rainy weather and store it up for the use of growing plants in dry weather. As Mr. Spillman says, this water in ascending to the plant roots, carries with it the many necessary soluble fertilizing elements.

Few persons realize the depth of tree root expansion. In one of the "Farmers' Bulletins" issued by the United States Department of Agriculture, a cross section of orchard land is shown which we reproduce on the opposite page. Note the scale on the sides, indicating that this tree has sent its roots downward 21 feet into the soil. This is natural growth. Under normal conditions a healthy tree will seek its food in this way; but suppose a layer of hardpan or compact subsoil is encountered at a depth of two to six feet? The roots must then spread out near the surface for twenty feet or more. The result of this unnatural sidewise growth is that each tree in the orchard is compelled to go over into the feeding supply of its neighbor and consequently does not receive the necessary amount of plant food to properly nurture it and allow of its healthy growth. Its yield of fruit is also lessened by this forced encroaching of one tree on the feeding ground of its neighbor. Then, too, a brief dry spell exhausts all the moisture from the thin feeding ground of the tree, stopping its growth or killing it. From this it is not to be assumed that natural lateral growth is undesirable, but simply means that hardpan prevents practically all downward growth. A tree growing under these conditions is also quite likely to be blown over by wind.

Dynamite blasting proves a simple and effective remedy for this condition. The blast breaks up the hard soil and permits the roots to take their natural downward course into the lower strata in which plenty of plant food elements are available. Under these conditions, one tree is not interfered with by another; each one receives the benefit of all of the soil allotted to it when at the time of planting the surface was measured and laid out.

It must not be assumed that dynamite blasting is beneficial only when the top soil is underlaid with hardpan. It is of the utmost importance to assist a tree, especially a young one, to send its roots out into its feeding bed as easily and rapidly as possible. The more porous and mellow the soil, provided it is one of the type of soils liable to be found in compact condition, the more rapid will be the growth. Even in the deep loamy soils of Oregon, among the most perfect for fruit tree culture found in the United States, blasting has proven extremely beneficial in forwarding the growth of young fruit trees, as is shown in the letter of Orchardist Rawley, which appears on page 37 of this booklet.

The main object to be sought in tree planting is to so prepare the ground that the growing tree can absorb the largest possible percentage of moisture from the soil which it occupies. Loosening and aerating the soil permits it to absorb more of the rainfall and store it against the future needs of the tree. A Cornell University authority advises that a tree planted in soil properly prepared, can absorb 60% of the moisture contained in it.

Professor Fabian Garcia, of the New Mexico Agricultural Experiment Station, who has conducted a considerable amount of experimental work, much of which was in an intensely practical way, makes the following statement:

"The hope and desire of every orchardist is to have the roots of his fruit trees grow down as deeply as possible. There is no doubt that the deeper the roots grow the better it is for the trees, and the longer lived they are."

Dynamited New Trees Successfully Survived Drouth

New Albany, Ind., June 29, 1911.

Gentlemen:—I used dynamite in planting my orchard of more than four thousand trees. I used one-third of a stick of 40% dynamite for each tree. I drilled a hole for each tree about two feet deep and tamped the dynamite tightly, exploding each charge with fuse. The explosion loosened the soil within a radius of about four feet to a depth of about thirty-six inches.

With my long experience of planting trees, I find the use of dynamite the most successful method. The loosened soil acts as a reservoir to hold moisture. I planted my orchard in the spring and find that my loss of dead trees will not exceed 5%, notwithstanding the fact that we have had a six weeks' drouth, this low percentage being due to the loosened soil holding moisture. Under no circumstances would I think of planting an orchard without the use of dynamite. I recommend it as the cheapest, quickest, most successful and most satisfactory method.

NEWTON A. GREENE, Mayor, City of New Albany, Ind.

Dynamite Method is Most Economical

Most fruit growers who have tried dynamite for tree planting are ready to admit that the method is productive of good results, and that the work can be done more quickly than by old-fashioned methods.

Many hesitate to adopt it, however, because they reason that it is more costly. There are some features of this question of cost that deserve serious consideration. Many people deceive themselves when they attempt to figure costs.

Dynamite Prevents the Big First Year Loss

According to those who have used dynamite for tree planting, the loss from death of trees planted in that way is considerably lower than when trees are planted in spade-dug holes.

Mr. J. H. Baird, Superintendent of the famous Hale Georgia Orchard, of Fort Valley, Ga., one of the most experienced and highly trained orchardists in the United States, says that Mr. Hale's loss of trees planted with dynamite does not exceed 2 per cent., whereas the trees planted on their Georgia properties in the old fashioned way have suffered losses of around 50 per cent.

Dynamite Saves New Settings, Although Ground Had Never Been Plowed

PARKERSBURG, W. VA., July 8, 1911.

Gentlemen:—Our first experience with dynamite in orchard work was during the spring of 1911. The season in this locality has been extremely unfavorable for starting a young orchard. The soil has been unusually dry ever since the trees were planted.

As we considered the use of dynamite in the orchard work in the nature of an experiment, we left a number of checks for comparison. We used dynamite for digging holes for planting of apples, pears, quinces, cherries and plums. In all these, the trees were planted in sod, and the ground was not broken except with dynamite. In other portions of our orchard the same kinds of trees were planted in ground that was carefully plowed and has been since cultivated several times. There is no decided difference in the trees planted by the two methods. Where the trees were planted in sod, however, without the use of dynamite, from *sixty to seventy-five per cent. are dead.* Whereas, where the dynamite was used, the loss will not exceed *two or three per cent.,* and in the cases where the loss occurs, the cause is foreign to natural conditions.

In addition to the large fruits above mentioned, we have just recently cultivated a vineyard by putting in small shots one-third of a stick each, every eight feet in the row. We were led to do this after seeing what we believe to be decided benefits in its use for planting and cultivating apples and other fruits.

In addition to this, we used dynamite for cultivating, in a limited way, an old orchard. The trees in this orchard are from twenty to thirty years of age. Up to the present season the orchard has been badly neglected. We used one-third of a stick directly under the trunk of the tree, about three and one-half feet deep. The explosion did not disrupt the surface but evidently broke up the subsoil and destroyed the old formation which bound the roots of the trees. This was used early in the season before the trees were in bloom. These trees at this time show a decided advantage over trees in the same orchard under like conditions, which were not so treated. The growth has been *at least twenty-five per cent. greater, they are loaded more heavily with fruit than the other trees, the fruit is larger in size,* and the leaves and general appearance of the trees indicate a more vigorous thrifty condition. We consider the use of dynamite in the cultivation of an orchard, as above described, one of the most beneficial purposes to which its use is adapted.

Our experience, up to this time, indicates a more extensive use of dynamite in the future. Its use is both expeditious and economical. Its benefits are peculiarly apparent in a dry season like this. By its use the roots of the trees are permitted a greater penetration than would be possible by any other method, thus, to a certain extent making the tree independent of surface conditions.

We used, approximately, a ton of dynamite this season, without the slightest accident. The men become familiar with its use and do not consider the labor hazardous.

ROSEMAR ORCHARD COMPANY.

From this it is apparent that in considering the question of economy we must go beyond first costs. Assuming that young apple trees, for instance, cost 20 cents apiece, and that 1000 are planted. If 2 per cent. of them die, the loss will be 20 trees, worth $4.00. If 50 per cent. die, the loss will be 500 trees, representing a money loss of $100.00, which the dead trees cost. To plant 1000 trees with dynamite would cost for materials from $60.00 to $65.00. Leaving labor out of the calculation altogether, the orchardist saves $96.00 worth of trees by planting with dynamite. Charging the $65.00 blasting cost against that, still leaves him $31.00 in pocket in spite of the outlay for dynamite, caps and fuse.

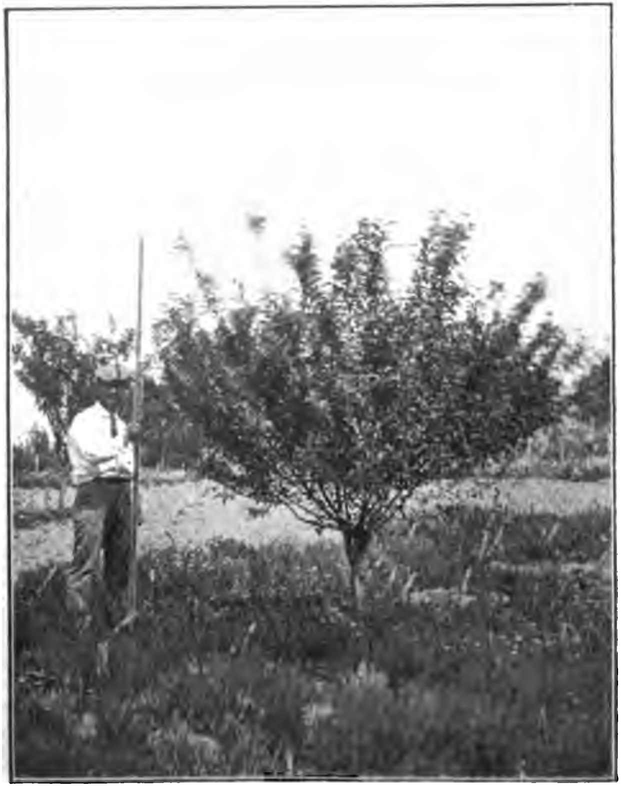


FIGURE 5
Six-Year-Old Apple Tree, Planted in Spade-dug Hole, Rose Cliff Fruit Farm, Waynesboro, Va.

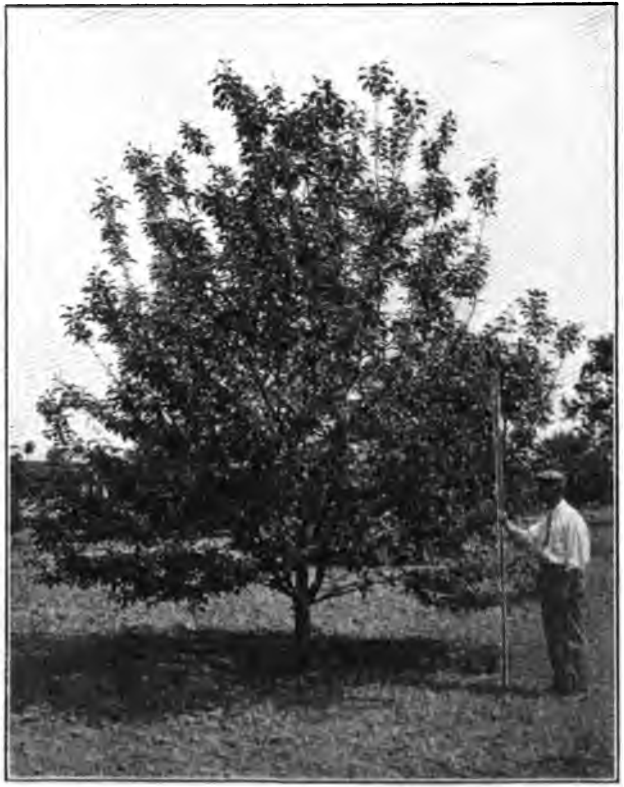


FIGURE 6
Six-Year-Old Apple Tree, Planted with Dynamite in Same Orchard as Tree in Fig. 9

Dynamite Saves Time and Labor

But that is not the only saving. It seems to be very generally admitted by those who have used dynamite for tree planting that the work can be done much faster by that method than when the holes are prepared with spades. The saving in labor, then, becomes a large item. If trees are planted according to the most approved horticultural methods—that is, in very large holes dug out to thoroughly pulverize the soil for from two to three feet in every direction from the trunk of the tree, and to a depth of at least two feet—a laborer can plant a tree with dynamite in one-tenth the time it takes to plant it with a spade.

One Blaster Replaces Twenty-five Tree Planters

The following is quoted from a trade report of a Du Pont Salesman:

"When I called on this party (Dr. J. T. Kelley, of Quicksburg, Va.) he had about 25 men out digging holes and had never thought of using dynamite, although he had heard of it. After talking to him a few minutes I asked him if he would take the time to go over in the field and let me show him how it was done. I had the necessary explosives with me. He gave me the time and I got him to thinking. He asked me to stay all night and give him a chance to think it over. So I stayed and talked over the whole thing with him that night, and before we retired he asked me if I would go with him up the country early in the morning to where he had his men digging and show them all about it. He said if he decided to blow the holes he wanted the men to understand all about it, and that they would understand better if they saw it. By 7.15 we were at the farm and found 25 men working. He called them all to quit work and come and see how we could blow holes. I could not look the men in the face for I felt it meant their jobs, and after I had shot a hole or two, I heard one fellow say, 'That fellow is going to cut us out of our job.' Sequel: In one hour they had all been paid off for half a day's time and sent away."

Dynamited Trees Bear Earlier

There is also another feature that must be considered in connection with the question of economy—that is, the claim of experienced orchardists that trees come into bearing from one to two years earlier when planted in dynamited holes.

Gained Two Years By Planting With Dynamite

Gentlemen:—It may be a surprise to you to learn that I have been using dynamite for planting trees for a number of years, and have some shade trees planted in that way eighteen or twenty years ago. They are the finest trees I have ever seen grow for their age. In the planting of peach trees I gained two years in six; in other words, I got as much fruit from a tree planted with dynamite at four years old as we usually get at six years old.

I not only plant them with it, but where a tree is failing and seems to be on the decline I start it off to growing again by firing charges from three to ten feet apart.

Nothing seems to tickle the earth so much as planting watermelons after explosion of dynamite from three to four feet under ground. I plant them twenty feet apart each way. Fertilize heavily and the vines bear right on until frost, the entire summer.

W. W. STEVENS, Orchardist, Mayfield, Ga.

It is not contended that this more rapid growth is due to the fact that dynamite is a fertilizer, but because the blasting makes the soil thoroughly porous and mellow, and gives the tree roots an opportunity to expand easily; also because the increased moisture-storage capacity of the shattered soil forwards the development of the tree. Therefore, the value of one or two years' crops must be added to the cost of the original tree planting in spade-dug holes, or deducted from the cost of preparing the holes with dynamite. This charge or credit, as the case may be, would more than counterbalance the one to three cents per tree, planting cost, which close calculating orchardists regard as the difference between planting in the old-fashioned way and planting with dynamite.

Of course, soil in which trees are to be planted can be properly prepared with ordinary tools, but to do it takes too much time, and the labor cost is excessive. It has come to be recognized among horticultural experts that the average tree cannot thrive when it is planted in a little spade-dug hole about the size of a large flower pot. Of course, that method of planting a tree doesn't take much time, and doesn't cost much, but the fruit grower pays the penalty by having to be satisfied with slow growth of his trees; with an excessively high death rate, and in many instances with light crops and poor fruit.

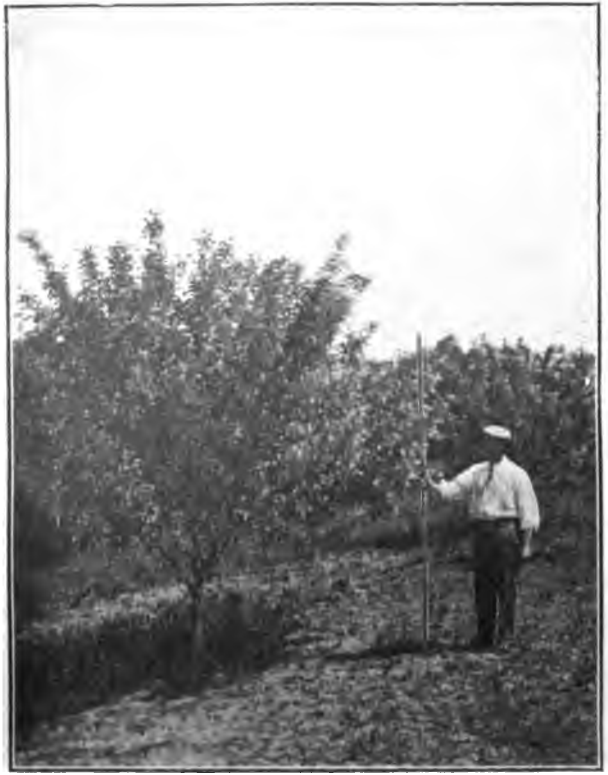


FIGURE 7

Nine-year-old apple trees planted in ordinary manner with shovel, same variety and age as Figure 8 and not 200 feet away, same soil. Apple trees planted 30 feet apart on square system.

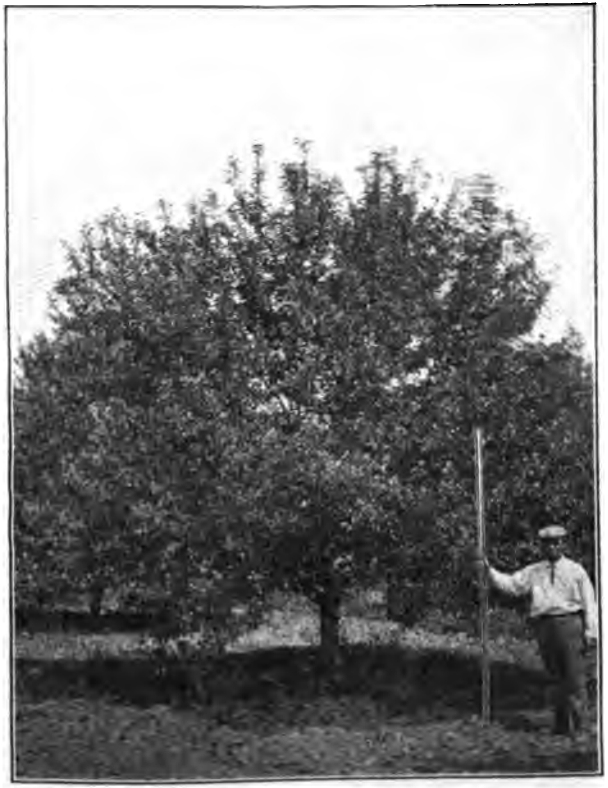


FIGURE 8

Nine-year-old apple trees planted in ground shattered with ½ cartridge 40% dynamite placed at depth of 18 inches. Apple trees planted 30 feet apart on square system.

The proper way to plant a tree with a spade is described in a paper on tree culture read by a horticulturist at the meeting of the Kansas State Horticultural Society, held in Topeka, Kansas, in December, 1909. The following are extracts from the paper:

"The soil should be stirred as deep as it well can be, the deeper the better. In digging your tree holes, forget that you are going to plant a tree, and imagine you are going to bury the largest horse on the place, and dig accordingly. Remember it is the last chance you will have to loosen up that soil, so do a good job. Plant your trees deep, getting the roots down where it never gets dry."

One of the largest and most successful nurseries in the country is that of the William H. Moon Company, of Morrisville, Pa. In their book, entitled, "How to Plant a Tree," they say: " Holes must be made so large that the roots may spread out naturally without cramping." That means for one- and two-year-old nursery stock a hole at least 18 to 24 inches across and nearly as deep. When an inexperienced fruit grower claims to be able to plant a tree for three or four cents per hole, of course, he tells the truth. He can; but he can't plant it right for that cost. He can also build a house for $9.00, but do you want that kind of a house?

To dig a hole as large as these experts advise, with ordinary tools, would require much time and labor. Half a cartridge of dynamite will loosen up the ground, and make it porous in an instant.

Expert Advice From a Professor of Horticulture

Deep-rooted Trees Resist Drouth and Frost

"I believe it is of fundamental importance to plant trees in soil loose and open enough, and well enough drained so the roots can go down deep. For example, the peach trees in the deep loam where they root deep blossom as early in spring as do shallow rooted peach trees in adjacent clay soil. Those in the deep, mellow loam, however, will endure more cold and will set full crops much more frequently than do these same varieties over a hard clay subsoil. The trees mature better, apparently store up more sugars and other materials in their buds for winter, and do not have their fruit buds killed at the same temperature as do trees on hard clay subsoil. We have taken twigs in full bloom, surrounded them with a freezing chamber so as to find out at just what temperature the bloom would be killed. Those growing in the deep well-drained soil will sometimes endure as low as 26 degrees, or 6 degrees below freezing, without the flowers being killed when in full bloom. Similar trees grown where they did not root down well, would not endure drought of summer in as good health, due to the packed subsoil, and often have their flowers killed at 28 to 29 degrees or about 3 degrees below the freezing point of water."

J. C. WHITTEN,
Professor of Horticulture, University of Missouri, Columbia, Mo.

Famous Orchardist Uses Dynamite in Planting and Renovating Peach Orchards

E. I. Du Pont De Nemours Powder Co., Wilmington, Del. February 22, 1911.

Gentlemen:—I am just back from a two weeks stay in our Georgia Orchards.

While I was there we continued further blasting for the replanting of about 3,000 trees where they had failed in one of our older orchards. I also looked over carefully the two little blocks of trees we planted with dynamite last season and the results are even better than I had been led to believe when I left there the middle of July. In the meantime I am becoming further interested in the matter and in the recommendations for renovating some of the old apple orchards in New England and want my clients to try dynamiting a portion of the land around these trees, especially when they are in particularly strong heavy soil.

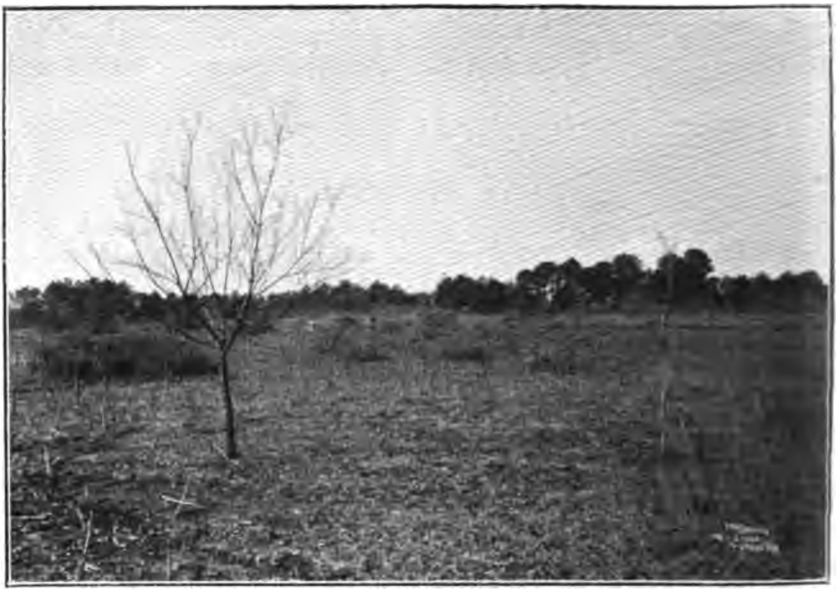
Yours,
J. H. HALE.

NOTE.—Mr. Hale is the owner of several of the largest commercial orchards in the United States.

Mr. Hale wrote us as follows, December 18, 1911:

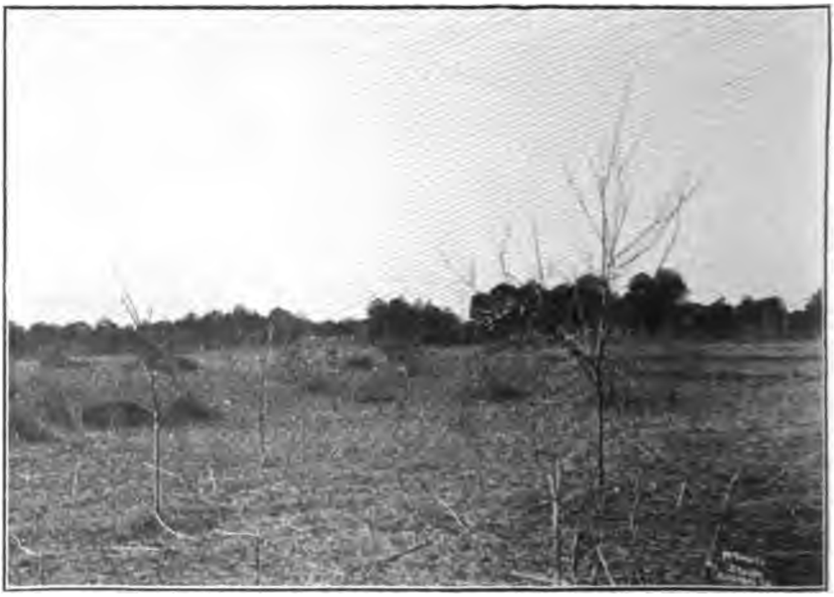
Our experiments with the use of dynamite in planting peach trees in our Georgia orchard in 1909, and continued on a larger scale the next two years, are giving us such promising results that I am inclined to go a little further into the matter in planting eight or ten thousand trees down there this winter, and possibly in planting quite a large lot of peach and apple here in Connecticut the coming spring, and so am writing now to know what special prices you can make us on the dynamite, caps, fuse, etc., delivered at Fort Valley, Georgia, as early in the month of January as possible.

J. H. HALE.



Dynamite-set **Spade-set**

FIGURE 9



Spade-set **Dynamite-set**

FIGURE 10

Pecan trees planted Jan., 1906, on land of F. W. McMurrain, Columbus, Ga.

(See page 21)

Dynamite Method is More Productive

Results of Blasting on Rose Cliff Fruit Farm

Dynamite Kills Fungus Disease   Makes Trees Grow Twice as Fast

Having learned that Mr. James Craig, President of the Rose Cliff Fruit Farm of Waynesboro, Va., has been using dynamite in the tree planting and regeneration work in his extensive orchards for several years, we sent an investigator to obtain his views. The following is a report of the interview:

Mr. Craig is a very progressive fruit grower. He is one of the first among Eastern orchardists to employ orchard heaters; as a result of this enterprise the fruit on his trees was saved in the spring of 1911, when a heavy frost killed all other fruit in the neighborhood. Mr. Craig has also used dynamite for killing fungus diseases in the ground under and around old trees which have died of fungus diseases. As a result, he has been able to use the ground for replanting, something which has been considered inadvisable previously.

Our representative obtained a number of photographs of trees on Mr. Craig's property, some of which we reproduce in this booklet.

Figure 1 shows a five-year-old apple tree planted where an old apple tree had died of a fungus disease, which indicates Mr. Craig's success in overcoming this dread disease.

Figure 6 shows a six-year-old apple tree planted in ground prepared by exploding a half cartridge of 40% strength Red Cross Extra Dynamite at a depth of eighteen inches.

Figure 5 shows a view of another tree planted in the same month of the same year by the ordinary method of digging a hole with spade and pick. By comparing the height of this tree with the man holding an eight foot rod in his hand, also shown in each picture, the difference in the size of the trees can easily be seen.

Figure 8 shows a nine-year-old tree planted in ground prepared by blasting a half cartridge of 40% strength Red Cross Dynamite at a depth of eighteen inches. Figure 7 shows a nine-year-old tree planted in spade-dug hole. The two trees just referred to are not 200 feet apart.

The soils in both plots shown are practically identical; the trees in these orchards are both of the same species of apple; but, as will be noted from the photographs, the trees planted with dynamite show very good growth, whereas the trees which were not planted with dynamite show up poorly.

In February of 1911, Mr. Craig did some blasting in his orchard, midway between his trees, with a view of loosening up the soil. He used in each hole one-half cartridge of 40% Red Cross Extra Dynamite, exploded at a depth of eighteen inches. One of the objects of this blasting was to break up some shale underlying a great many of the trees and preventing the deep growth of the roots. To see what results these blasts accomplished, some of the soil was afterwards dug out with shovels. It was discovered that the ground had been broken up at a radius of from six and one-half to eight and one-half feet from the point of the blast, thus giving the tree roots an opportunity for deeper and more healthy expansion.

Rapid Growth of Dynamited Trees

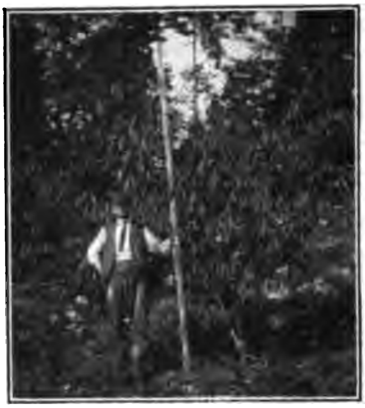


FIGURE 11
Dynamite-set

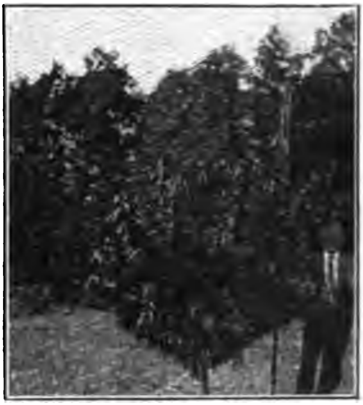


FIGURE 12
Dynamite-set

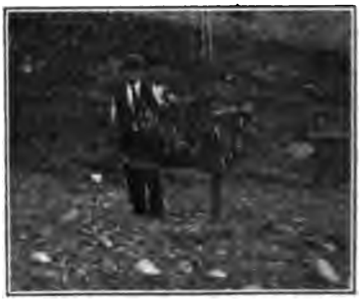


FIGURE 13
Spade-set

CRYSTAL SPRINGS FRUIT AND POULTRY FARM.

MARYSVILLE, PA., Oct. 7th, 1911.

I am sending you under separate cover photographs of three trees, the two largest being planted by holes being blasted with dynamite; the smallest by the hole being dug.

These three trees were planted the first week in November, 1909, making them 1 year and 11 months old from time of planting; these trees were one year from bud, between four and five feet high, and were cut back to fourteen inches. Trees were grown under the same conditions, having the same advantages of soil, fertilizer and cultivation.

The photographs show the average in the orchard, as we did not select the largest or smallest, but the medium-sized, trees in procuring the photographs, as you can form a more accurate idea of what the trees in the entire orchard are like than if we had selected the largest trees for the photographs.

Very truly yours,

SIMON LICK, Proprietor.

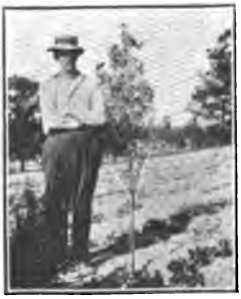


FIGURE 14
Planted with Dynamite
5 months old

Pear Trees Planted at Camp Farm Newark, O.

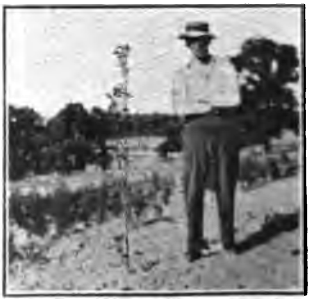


FIGURE 16
Planted with Spade
5 months old

Google

A Controversy Settled

MR. JAMES CRAIG, PRESIDENT, WILMINGTON, DEL., February 6, 1912.
Rose Cliff Fruit Farm,
Waynesboro, Va.

Dear Mr. Craig:

File A-3718: *ROSE CLIFF FRUIT FARM.*

Referring to the cuts used in our Tree Planting Booklet (copy of which I enclose), showing the comparison in growth between trees planted with spade and with dynamite in your orchard:

These pictures have been criticised by orchardists to some extent, as being an unfair comparison because the dynamited tree is in cultivated ground and the spaded tree is in ground not so well cared for.

I understand some people who have visited your orchard have also said that the smaller tree had not received the same attention in spraying, pruning, etc., as the larger tree.

Will you be kind enough to advise me whether there is any truth in these statements, and whether you think the pictures we are using are an unfair comparison or not.

I enclose a stamped envelope for reply, and would greatly appreciate your attention to this matter.

Very truly yours,
GEORGE FRANK LORD,
Manager Agricultural Division.

MR. GEORGE FRANK LORD, WAYNESBORO, VA., February 9, 1912.
WILMINGTON, DEL.

Dear Sir:

Your favor of February 6th received. In regard to the two trees that you make a comparison of, beg to say that there is probably some slight difference in the culture and care of these two trees, yet the care that the small tree has had should have developed as large a tree as the other one, as it has been sprayed well, has been cultivated and has also had two coats of barnyard manure while the other one has not had any barnyard manure at all, yet it has good culture and has been well sprayed. I think if the other tree had been set in a dynamite hole it would have shown practically the same growth. I am sure the ground will grow as fine a tree as the one shown in the picture. Of course it can be criticised and it is right hard to make a comparison of any two trees without showing some difference in the care.

I do not doubt that dynamiting the ground planted to trees is of the greatest advantage possible. The American Apple Company, of which I am Vice President, set the past May 500 "Delicious" trees on a sloping hillside and without any special care given them except dynamiting (as it was so late in the season we could not get the ground prepared as well as we would have liked), yet these trees have made a very fine growth, as fine as any we have set, and we only lost about three trees in the 500, yet we had a drought that was unprecedented in this part of the country. This satisfies me conclusively that the blowing of these holes offered a loose pliable ground for many feet around which retained the moisture and in this way the trees did not suffer, but made an immense growth which can be seen by any one visiting us.

Yours very truly,
ROSE CLIFF FRUIT FARM, INC.,
JAMES CRAIG, President.

Dynamite Used in Largest Peach Orchard in U. S.

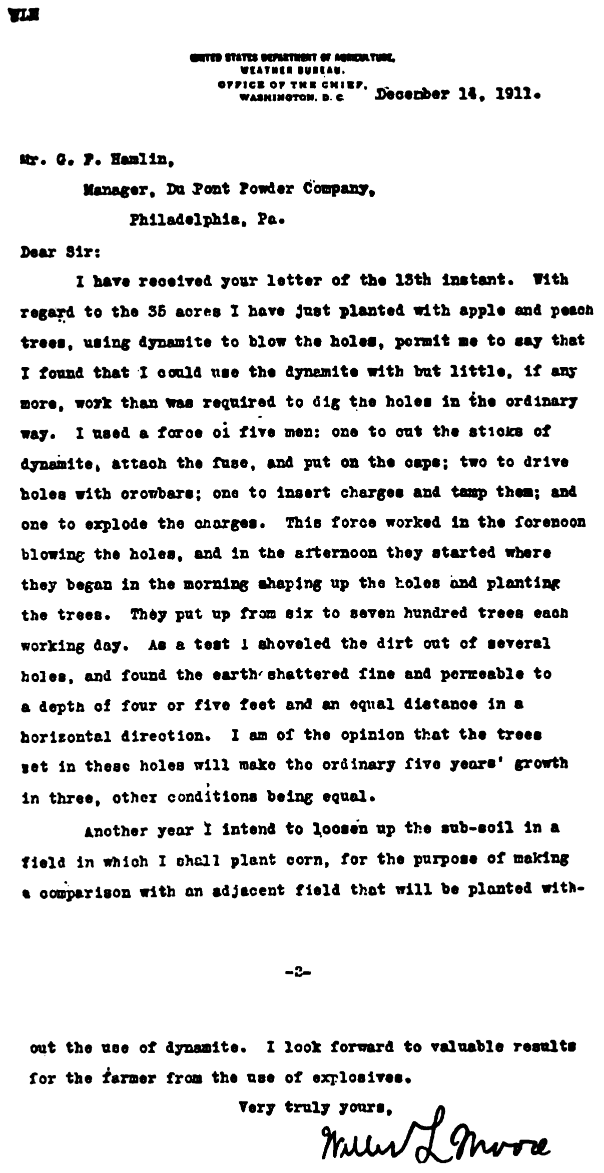
Superintendent J. H. Baird, of the famous Hale Georgia Orchard, of Fort Valley, Georgia, writes under date of May 20th, 1911:

"The trees planted this season with dynamite are growing beautifully and we have not lost any through drouth, while those planted without dynamite have died out badly and show poor growth."

On June 17, 1911, Mr. Baird again writes:

"Vegetation is burning up here for lack of rain, but the young trees have lived beautifully; do not think we have lost over 2% of those planted with dynamite, while of the others planted in the old fashioned way we have lost from 50% up.

Dynamiting Highly Endorsed by Chief Moore of U. S. Weather Bureau



WLM

UNITED STATES DEPARTMENT OF AGRICULTURE,
WEATHER BUREAU.
OFFICE OF THE CHIEF,
WASHINGTON, D. C.

December 14, 1911.

Mr. C. F. Hamlin,
Manager, Du Pont Powder Company,
Philadelphia, Pa.

Dear Sir:

I have received your letter of the 13th instant. With regard to the 35 acres I have just planted with apple and peach trees, using dynamite to blow the holes, permit me to say that I found that I could use the dynamite with but little, if any more, work than was required to dig the holes in the ordinary way. I used a force of five men: one to cut the sticks of dynamite, attach the fuse, and put on the caps; two to drive holes with crowbars; one to insert charges and tamp them; and one to explode the charges. This force worked in the forenoon blowing the holes, and in the afternoon they started where they began in the morning shaping up the holes and planting the trees. They put up from six to seven hundred trees each working day. As a test I shoveled the dirt out of several holes, and found the earth shattered fine and permeable to a depth of four or five feet and an equal distance in a horizontal direction. I am of the opinion that the trees set in these holes will make the ordinary five years' growth in three, other conditions being equal.

Another year I intend to loosen up the sub-soil in a field in which I shall plant corn, for the purpose of making a comparison with an adjacent field that will be planted with-

-2-

out the use of dynamite. I look forward to valuable results for the farmer from the use of explosives.

Very truly yours,

Willis L. Moore

More Proof That Dynamiting Kills Fungus

An important discovery was recently made by Mr. J. C. Whitten, Horticulturist of the University of Missouri. He found that fungus diseases which attack the roots of apple trees could be controlled or prevented by exploding a charge of dynamite in the ground beneath a dying apple tree, or under the stump of an old apple tree, or in the ground where a stump had stood and allowing the soil to weather all winter. This discovery saves much valuable orchard land, as formerly it was considered bad policy to plant an apple tree at a point where an apple tree had died, or a peach tree where a peach tree had died of a fungus disease.

Kills Fungus

ARBOR HILL NURSERIES, SALES GROUNDS AT SUMMIT STATION,
BROWNWOOD, TEX., Nov. 4, 1911.

One experiment I made while at Arlington, Texas, in application of dynamite will no doubt be of interest to you.

In spring of 1910 I planted a number of cherry trees upon a plot of land that was infested in spots by rot fungus; and I happened to plant one of these cherry trees in one of those spots; said tree was dead by the first of June, 1910, with roots rotted.

Last winter I placed a stick of dynamite about 30 inches deep in the same identical spot, exploded it and immediately planted another cherry tree, which grew well during all the past summer and fall without showing any indication of root rot.

I believe the organism of root rot disease is delicate enough that a shock occasioned by explosion of dynamite will destroy it within considerable distance of center of explosion.

Very truly yours,
CHAS. F. WARD.

Found That Dynamite Kills Fungus

Gentlemen: August 10, 1911.

A few years ago I experimented in planting trees with dynamite. It was a decided success. My neighbors observed the results and now many of them are talking of using this method hereafter. My observations were as follows:

1st. Made new land out of old. I made a drainage for stagnant waters and a receptacle for carrying moisture down in the wet season and up in the dry season by breaking up and pulverizing the soil and establishing a capillary attraction between moisture beneath and air above.

2nd. In resetting an old orchard of diseased or dead trees, it is regarded as fatal to reset, without digging the hole and letting it stand for a year or two. If the old tree is blown out with dynamite and let stand for a few hours with fumes imbedded, it will kill all fungus, bacteria, grubs, and animal parasites. The tree thus treated will grow and do as well as on virgin soil.

3rd. The tree will have more vigor and vitality, will grow faster, bear earlier, and be more productive and longer lived.

4th. The combined cost of blowing hole and planting tree is but a trifle more than digging hole and planting tree the old way.

Very truly yours,
J. A. TEAGARDEN, Auburn, Cal.

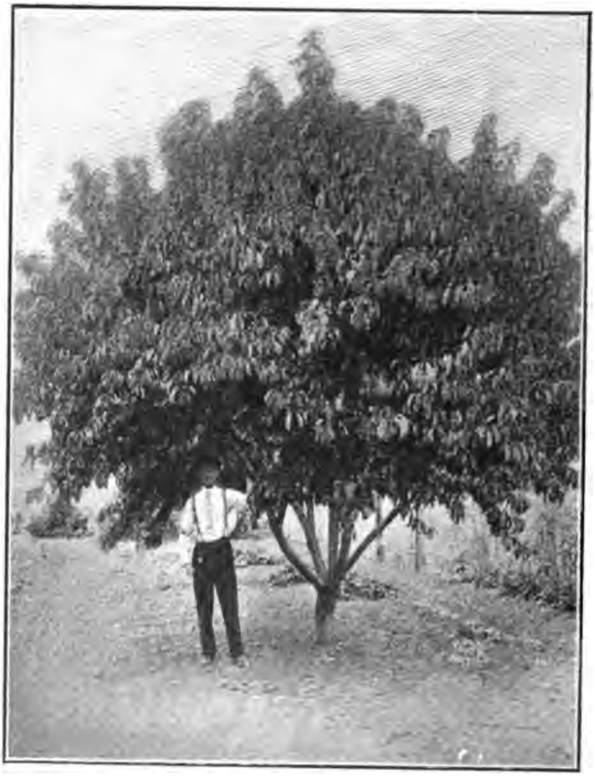
Two Men and Dynamite One Day Better Than Three Men One Week Without Dynamite

A. F. BORNOT BRO. CO., 17TH STREET AND FAIRMOUNT AVENUE,
PHILADELPHIA, PA., April 26, 1911.

Dear Sirs:

Your Mr. Fulmer was here Monday and together we made about one hundred holes which has enabled my gardener to plant one hundred peach trees the following day. Three men could not have done the same amount of work in a week. The ground is now very loose; I am more than pleased and would not plant another tree on my place without explosives.

Very respectfully,
A. F. BORNOT BRO. CO. L.



Results of Planting Peach Trees With Dynamite At Medford, Ore.

This view shows a five-year-old peach tree, planted with dynamite. Two of these trees produced 18 boxes of peaches, from which 12 boxes of fancy peaches were obtained, as shown in the lower illustration.

FIGURE 17

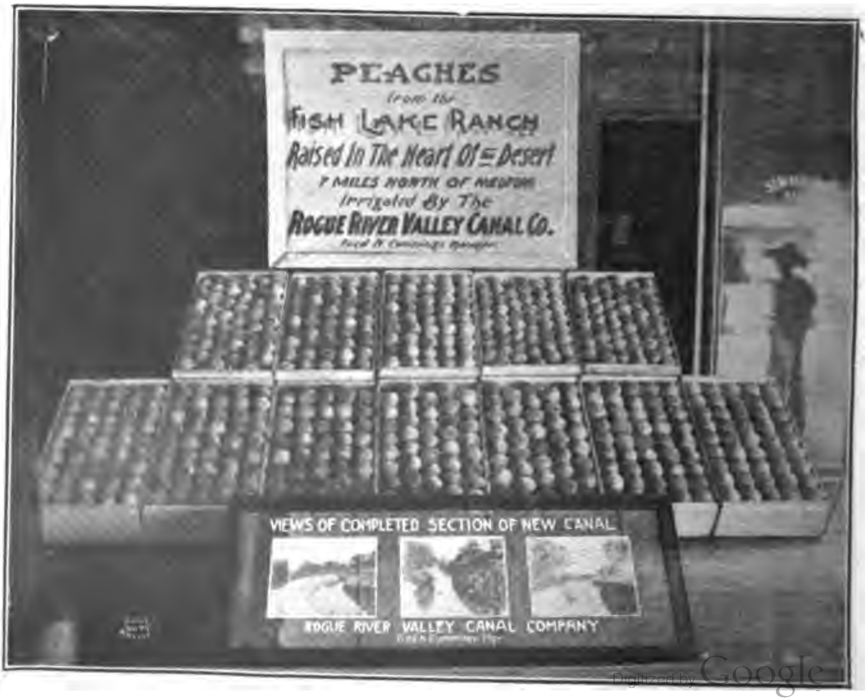

PEACHES
from the
FISH LAKE RANCH
Raised In The Heart Of the Desert
7 MILES NORTH OF MEDFORD
Irrigated By The
ROGUE RIVER VALLEY CANAL CO.
VIEWS OF COMPLETED SECTION OF NEW CANAL
ROGUE RIVER VALLEY CANAL COMPANY

FIGURE 18

Proved Value of Dynamite in Peach Orchard

Mr. W. R. MacDonald, of Columbus, Kansas, reported that he planted 9 peach trees a few years ago to determine positively whether anything was to be gained by using dynamite. Three of the trees were planted in holes made by drilling a two inch auger hole three or four feet deep and detonating a charge of explosives in the bottom; and the other six were planted in holes of the regulation size dug by hand. Three years later, the trees which had been planted in the blasted holes were stronger and healthier, and produced between five and six bushels of very fine peaches, but the six trees planted in the same ground without blasting bore practically no peaches, both fruit and leaves having shriveled up and dropped off during the dry season.

Dynamite Successfully Used in Planting Pecan Trees

Mr. S. H. Bolinger, President Clear Creek Lumber Company, Shreveport, La., writes us under date of April 26th, 1911, that he used dynamite in blasting the holes in which 1,080 pecan trees were planted a year ago; also for planting 8,000 peach trees. He says the percentage of loss on the pecan trees (which are among the most difficult to set so that they will live) was almost nothing compared to the loss on other trees planted in the ordinary way.

Mr. Bolinger explains how the planting was done. The soil was a hard sand clay. A 2-inch auger with a long shank was used and a 2-inch hole bored about 4 to 4½ feet deep. In the auger hole one stick of 40% Dynamite with fuse and blasting cap attached was inserted, the hole filled and lightly tamped; then exploded. The explosion created a space of about the size of an ordinary barrel. The ground was not blown out, but was simply raised on the top about 3 or 4 inches. In almost every case, however, it could be seen that the ground had been thoroughly loosened up for a distance of 10 to 15 feet all around the hole. A post-hole digger was then used to bore through the top surface to the vacant space below; the surface soil necessary to bore through was about 10 to 15 inches thick. The topsoil was then filled in to the depth necessary and the trees planted in the holes, the ground being well packed around the roots.

It is Mr. Bolinger's opinion that the planting was successful because the opening up of the soil under the trees by exploding the charge of dynamite created a space for the storage of moisture which was held throughout the dry spell that followed the planting and thus kept the trees alive and in healthy condition.

Dynamite Reduced First Year Loss 19%

E. I. DU PONT DE NEMOURS POWDER CO. COLUMBUS, GA., February 22, 1912.

Gentlemen:

The largest trees in the photographs sent you to-day were set in dynamited holes, and the smaller trees in spade-dug holes. I could have shown you a good deal larger trees than we did, but could not get the two on the same view. However, I hope they will be what you want. The trees were 30 feet from the camera.

As to the value of the crop of pecans from the dynamited trees: They bore the fourth year from 10 to 20 nuts per tree, the fifth year from 20 to 75 nuts, and last year most of them bore from one to two pounds to the tree; and the spade-dug hole trees had some of them 4 to 10 nuts per tree but most of them have not borne any as yet.

I planted four different varieties of pecans but the ones I made your picture from are both of the Stuart Pecan Trees.

You ask what per cent. of the dynamited trees died. I only lost two trees from the 35 dynamited holes, and 16 from the 65 spade-dug holes that were set the same day, all in the same patch, and all had the same care.

This, you will note, shows that while 25% of the spade-planted trees died, only 6% of the dynamited trees died. In other words, the dynamite reduced the loss 19%.

The land on which these trees were planted was a hard clay land, and although I have 800 pecan trees from 4 to 8 years old, my only wish is that I had used Red Cross dynamite on all of them. I will set out 200 more of these pecan trees during 1912 and I shall certainly use Red Cross to blast the hole for each tree.

Another point in favor of using Red Cross dynamite is the fact that planting in dynamite-dug holes cost me 10c. per tree; and the trees are about three times as large as those planted in spade-dug holes, which cost me about 30c. each.

Yours respectfully, F. W. McMURRAIN.

Wanted Proofs and Got Them

A subscriber to the "Rural New Yorker" wrote the editor of the paper the following letter:

Dynamiting for Planting Fruit Trees

What information can you give as to the use of dynamite for planting fruit trees? I expect to set out quite a few this Spring, and am wondering if it would be the thing to use on my land, which has a shallow top soil, about 18 inches of gravelly subsoil, underneath which is a very hard, clay hardpan. The dynamite makers claim great things for their product. I would like to hear what others have to say who have used it.

Connecticut. J. W. M.

R. N.-Y.—We want actual experience about this if we can get it.

In an issue of the *Rural New Yorker*, published two weeks later, the following letters from subscribers were published in answer to J. W. M.'s inquiry:

Dynamiting in Tree Planting

In answer to J. W. M., page 126, in a block of seven-year-old apple trees, about a dozen failed to make a good growth, and one of them died when four years old. Replanting, the tree failed to live through the Summer. The soil is Hagerstown shale loam, and we found the shale very near the surface in this place. Before planting the third time we used about one-third stick of dynamite (say three ounces), making the hole with a bar and putting the charge about two feet under surface. The result was a mass of fine shale of about a cubic yard in extent. The tree was planted and grew and made a good growth, although the season was very dry. J. W. M. would have to get well into that hardpan with his dynamite and use more of it, say one-half pound. I think the cost would be justified in the better drainage secured, as unbroken hardpan within two feet of the surface would hardly be an ideal condition for an apple orchard.

Pennsylvania. A. T. B.

I planted 150 trees with dynamite with the best success; they make a much quicker growth. They will grow in two years as much as the old way will in three years. If the soil is very hard digging, it will be found much cheaper.

Massachusetts. C. M. O.

J. W. M., Connecticut, wants actual experience in dynamiting holes for fruit trees. I tried that last Spring for over 100 peach trees in heavy clay subsoil on land that would raise scarcely more than 20 bushels of corn to the acre. I used an iron rock drill and drilled down about three feet, and used one-third stick 40 per cent. dynamite. The dynamite fuse and caps cost about four cents per tree, which I think is a very cheap way of digging the holes, as all I did after I shot the holes was to shovel out a few shovelfuls and set the tree. As last season was very dry with us the trees made good growth; they were headed back to about 18 inches from the ground and about five-eighths inch in diameter when set, and now they will average seven feet tall and most of them will average two inches in diameter, and some larger than that. This ground was in corn the season before, and the patch was set in straw and tended up to September. One of my neighbors set peach trees last Spring in the spade-dug system and those trees made very little growth. We have a man near New Albany, Ind., who runs a commercial orchard system; he has been trying it 12 years and I heard him say he would set no trees without dynamiting, thinking it paid largely. From what experience I have had and seen from others I would certainly try dynamite, for it certainly tears up the subsoil and gives those roots a chance to go down to moisture, and dry as the season was, I never lost a single tree out of 104, which I think is very good. R. F. T. BORDEN.

In the Spring of 1911 I set 52 apple trees in filling in an old orchard where the trees had died. First tried one-fourth pound, but found that too heavy a charge as it made too large a hole; then used one-sixth pound charge. First I bored in about 12 to 15 inches, pushed the stick clear to the bottom, tamped it well and let it go. We could set a tree in the hole easily in five minutes, one holding the tree and treading in the dirt as the other shoveled. Not having enough dynamite, two holes were dug with shovel. Result, one of those trees died and only one of those set in holes that were dynamited. The soil is a sandy loam underlaid by sand rock about three feet below the surface. All trees were heavily mulched with straw early in the season before the drought began. Some of the trees made a new growth of more than two feet on each limb, while the tree set in the dug hole made a growth of three to six inches. An observation of the trees is proof conclusive that it paid to use the dynamite. The trees set were two years old.

Ohio. H.

We are using dynamite here for setting grape roots, and it is a good thing for clay or hardpan; do not think that it would do any good in mellow or gravel soil. It would be necessary to get the dynamite down in the clay and to tamp the ground down hard around the dynamite before firing the fuse; the explosion then would loosen the ground in all directions, and would enable the root system to extend more quickly.

Hammondsport, N. Y. J. W.

Last Spring in preparing for planting fruit trees I decided to use dynamite, which was so entirely successful I shall give you my method. For making the holes I used a heavy iron bar, sinking it from 20 to 24 inches, using one-quarter stick dynamite, pulverized, then after placing cap and fuse tamped wet earth into hole. This would loosen the ground four or five feet deep and about four feet on each side, in ordinary freestone soil with heavy yellow clay subsoil. My trees made larger growth last year, where other trees in the neighborhood which were dug in, made very small growth or died from the dry weather. Care should be taken to pack soil well around trees when put in. Cost of material for shooting holes was five cents each, not including labor.

Seebert, W. Va. W. M. I.

Editor's Note.—Neither the inquirer nor endorsers were known to us.

Prominent Nurseryman Describes Successful Methods

Harrison Brothers, with nurseries at Berlin, Maryland, have 4,000 acres, which contain more than 200,000 trees, and they are among the leading nurserymen of the East. They have prepared a very complete book entitled "How to Grow and Market Fruit," retailing at $.50 a copy, containing valuable information based on their thirty years' experience.

They say, "What is stated here is the most practical kind of hard-won knowledge, for it outlines 'how we do it' in fruit-culture."

From the chapter on "Methods of Keeping Moisture":

"Subsoiling with dynamite is a thoroughly practical method, and should be employed on three-fourths of the farms of the East.

"By far the best way to loosen subsoil is with dynamite. This is not generally known, but orchardists will find they can reduce tillage expenses greatly and save much time with it. The exploding of from a sixth to a half pound of the right kind, two or three feet under the surface, loosens and makes fine all the soil. Young trees will make great strides if they are planted in dynamited holes.

"The dynamiting can be done in orchards or about trees of *any age*. If done rightly, it will accomplish the work without breaking or tearing away any roots, leaving the soil in condition to give the roots twice the feeding-ground they had before and providing perfect drainage and water-storing capacity. The use of dynamite is the secret of success in growing fruit by mulching systems without so much plow and harrow tillage."

From the chapter on "Cultivation":

"It is necessary to break up the subsoil, whether there is hardpan or not. The dynamite method usually is the cheapest at any time, and it is the only way by which the work can be done thoroughly after the trees have been in three or four years.

"Dynamite is the thing with which to dig holes for new trees, to break up the whole soil three or four feet deep every few years, and to help renovate old orchards, because it will do these things more cheaply and better than they can be done by any other means. If you have fruit trees, which seem to be standing still and which do not bear, no matter how big they are, properly explode a charge in the soil around or between them, and the trees will likely get to work. In a bearing orchard, a proper charge midway between trees is always safe and is generally very effective."

From the chapter on "When Trees Will Not Bear":

"Explode a charge of dynamite under each tree, and three or four others a few feet away. Mulch the surface with a thick covering of vegetable matter, or by keeping a couple inches of dust under the tree. Feed with commercial fertilizer."

From the chapter on "Grapes":

"Vines are heavy feeders. Their roots extend far out and make a net-work in the soil. The proper distance to plant will be from six to eight feet apart, although sometimes this can be changed to advantage. Strong varieties, on fertile soil, need more room than small growers on poor soil. Before planting is done, the ground should be worked even more thoroughly and deeply than for a tree. Remember that you are planting something which will last a generation, not a crop to be removed in a season or two. Plow the land, use dynamite to dig the holes, and have a clearance inside the hole of at least twenty inches."

A Success in the Empire State

NIAGARA RIVER NURSERIES AND FRUIT FARM.

YOUNGSTOWN, N. Y., November 27, 1911.

The trees planted April 23, 1910, with dynamite did so nicely that during the spring of 1911 we planted several hundred trees in holes dug with dynamite and in every case the trees so planted grew and made one-half more growth than trees planted in the usual way.

We think so well of the process that we shall plant all of our trees during the spring of 1912 with dynamite.

On our soil, which is a very hard hardpan, we can dig the holes for one-half the cost of digging with spade. We now feel confident that the shattering of the soil is a great advantage. Last season was the dryest ever known in this section and yet our trees where holes were dug by dynamite kept green and grew right along. I think we will get a better and a deeper root system.

We used only one-third of a stick for peach trees and that gave us a fine hole 2 feet deep and a good breadth. We stake our ground out, drive a hole where the stake stood, insert the charge and the work is done in an instant. One man can keep a fair gang busy following up and putting in the trees.

HENRY LUTTS.

Cultivate Spade-set Trees With Dynamite

We frequently receive letters from orchardists stating that they had planted trees in their orchards a year, two years or three years ago which are not doing well because of hardpan conditions beneath the surface soil or because of compacted soil or insufficient moisture storage capacity of soil. These orchardists express the keenest regret at having learned about tree planting with dynamite after their orchards have been planted. They tell us they believe their trees would be in a much better condition had they been planted by this method.

If their trees are alive, there is no occasion for repining. The subsoil in which the trees are planted can still be broken up by subsoil blasting between the trees. This rejuvenation work will give the trees the same favorable opportunity for growth and development that they would have had had they been planted in holes prepared by dynamite blasting in the first place.

Millions of fruit, shade and ornamental trees are standing in the orchards, parks, yards and along highways in this country. Many of them are very valuable because of the fruit they are capable of producing. Others are highly prized by their owners because they serve to ornament and shade residence properties or parks; others add greatly to the appearance of city streets.

But many of these trees are in an unhealthy condition. This may be due to various causes. An investigation will show that soil conditions are at fault as often as any other cause. Many of these soil conditions may be remedied by subsoil blasting between the trees. If the soil in which the tree is planted is compacted so that it is difficult for the roots to make healthy growth into the deep subsoil, or if the soil is not sufficiently porous to permit of the absorption and storage of moisture, blasting with dynamite will prove an effective remedy.

Following are copies of letters tending to prove the efficacy of this treatment. The letters refer to both fruit and shade trees:

In every part of the United States will be found trees in parks and along public highways showing signs of deterioration. Sometimes these conditions are due to the fact that the trees are planted in poor soil; sometimes because they are in soil underlaid with hardpan or compact subsoil; sometimes because their roots grow out under asphalt, cement or flag pavements which prevent them from obtaining the benefit of rainfall. In any of these cases the use of dynamite will improve the health of the tree.

The Park Commissioners at St. Louis and Joplin, Mo., and Los Angeles and San Diego, Cal., have recently used dynamite for these purposes with excellent results. In St. Louis 200 trees were planted at a cost less than the work could have been done by labor alone.

Mr. Kieth, a Park Commissioner of Joplin, Mo., is a member of the National Park Association and intends making a report to the Association of the results obtained in his city. His experience in planting walnut and black locust trees was such that he says he will always plant trees with Du Pont dynamite hereafter.

STONINGTON, Aug. 23, 1911.

Last Spring I used your dynamite to try to improve an old apple orchard, planted over 60 years ago, which has borne little or nothing for the yast four years.

The trees were planted 30 feet apart, and had been badly neglected and untrimmed.

I used a half a stick of dynamite between every tree last April, and have been much gratified at the result.

The entire orchard is loaded with apples, and their weight has broken down one tree, and broken limbs of many others.

I think the apples are much larger than usual.

I have also used dynamite in blasting out rocks, with very good results, and am intending to use it more extensively another year.

Very truly yours,

EUGENE P. EDWARDS.

Rejuvenation of Trees Within City Limits

Every old town has many trees along the streets that are failing, from one cause or another, but mostly from root cutting on streets where sidewalks have been laid, cutting off their former supply of nourishment. In this contracted space the tree soon exhausts what little fertility is within easy reach.

Many an old dying tree have I resuscitated by a half dozen small charges of dynamite below the root system, often filling the hole after the charge is in with some fertilizer which will be scattered through the soil close by the roots, giving them the immediate effect.

I use this same method in orchard dynamiting and it works wonders. Often the effect can be seen in ten days after treatment.

M. J. WALTERS,
Elyria, Ohio.

Unprejudiced Advice

Blasting California Hardpan for Trees

Sacramento, Cal., Jan. 21.

Editor Western Empire:—I have been reading several articles on plowing with dynamite, also the breaking up of hardpan by the same means, and would like your advice on the subject. I have ten acres underlaid with hardpan at a depth ranging from eighteen inches to four feet, which is from one to nine inches in thickness. I am desirous of planting fruit trees and would like to break up the hardpan for each tree, but find that the cost of using powder, and labor involved, is a little beyond my means. I have seen practical tests made and examined the ground after blasting, and find it would take considerable dynamite to break the hardpan in its thickest part, also it is impossible to tell whether the hardpan is broke thoroughly or not when covered with two or three feet of soil. I wish to know if I get as good results by boring holes with an ordinary hand-power well-drilling rig. By boring a six to twelve-inch hole, five or six feet deep, it seems to me it would give as good results, and be more certain of breaking through the hardpan than dynamite. I have helped to drill several wells, and know it would only take two men a short time to go a few feet deep. If you will please advise me in the matter by letter, or in an early issue of the *Western Empire*, I shall be very much obliged to you.

Yours truly,
T. N.

(The editor replied as follows:)

The writer has done a very considerable amount of blasting for trees and vines, and from results fully recognizes the practical value of a judicious use of dynamite for breaking the hardpan.

We would not plant any hardpan land to trees without blasting every tree hole. The expense of this is not to be considered in comparison with the benefits that will come from good tree growths and profitable bearing orchards, as a result of breaking the hardpan, to give the trees deep root systems.

We think your proposition to drill well holes through the hardpan is hardly feasible. In practice, it will cost to drill the holes, then fill them with earth, then dig the tree holes, as much, or nearly so, as the cost of blasting. And after such well holes are drilled, the main object of having the largest area of ground prepared properly for the planting is not accomplished. Even if this drilling could be done at much less cost, we would not resort to it, for results in the life of the orchard would be a perpetual tax on the mistaken economy.

This is what we do:

First lay out the orchard, having a whitewashed peg where the trees are to stand. Then, instead of using the ordinary tree planting boards, make one at least ten feet long. This board is made out of a one by four, by boring inch holes in the ends and midway between them making a shaped notch.

In using this implement, place this notch over the tree peg, and set two pegs through the end holes and withdraw the tree peg. After the holes are dug the board is placed over the end pegs, and the notches in the board indicate the exact position where the tree should be placed.

Now dig an ample tree hole to the hardpan, and drill into it according to its thickness. From your description of the hardpan this will be an easy matter.

Much judgment is to be exercised in determining the kind of powder to use and the amount. The object to be obtained is a thorough breaking and cracking of the hardpan, and the wider the area of this action the more effective. Hence a slower action of the charge is often better than a more violent explosion. Good judgment and some experience will soon enable one to determine the depth of the drill holes, and the amounts of the powder to use.

Dynamite is made of different strengths and longer or shorter sticks can be used. Where the hardpan is a thin layer, and more or less seamed, it may be better to dig a small hole to the hardpan for the drilling rather than the larger hole as suggested.

Where hardpan is five or six feet deep, or where the subsoil is of a close, tenacious nature, it is a wise practice to make a deep hole with a bar or small earth auger at the point where the tree peg was removed, and explode a charge heavy enough to thoroughly shatter the subsoil.

A man used to this kind of work will get over quite an area of orchard ground in a day's time.

Success With California Hardpan

ARLINGTON HEIGHTS FRUIT COMPANY.

Riverside, Cal., December 16, 1911.

Gentlemen:

Some ten years ago we began shooting in our orchards where hardpan conditions existed. You will appreciate that in most districts in California the hardpan exists to a greater or less extent. With us it is not found to any great extent, but rather in deposits here and there. Where found, whether near the surface or deeper down, it is a great detriment to the proper and rapid development of the trees, and their profitable production when grown.

For this reason we determined upon shattering the hardpan, and at first it was an expensive matter, for we used the dynamite and then, in order to make a very thorough job, blew the hole afterwards with from one-half to a full keg of black powder. At times we shattered the ground for a radius of from ten to twelve feet and blew the soil and

Orchard Rejuvenation in California Hardpan

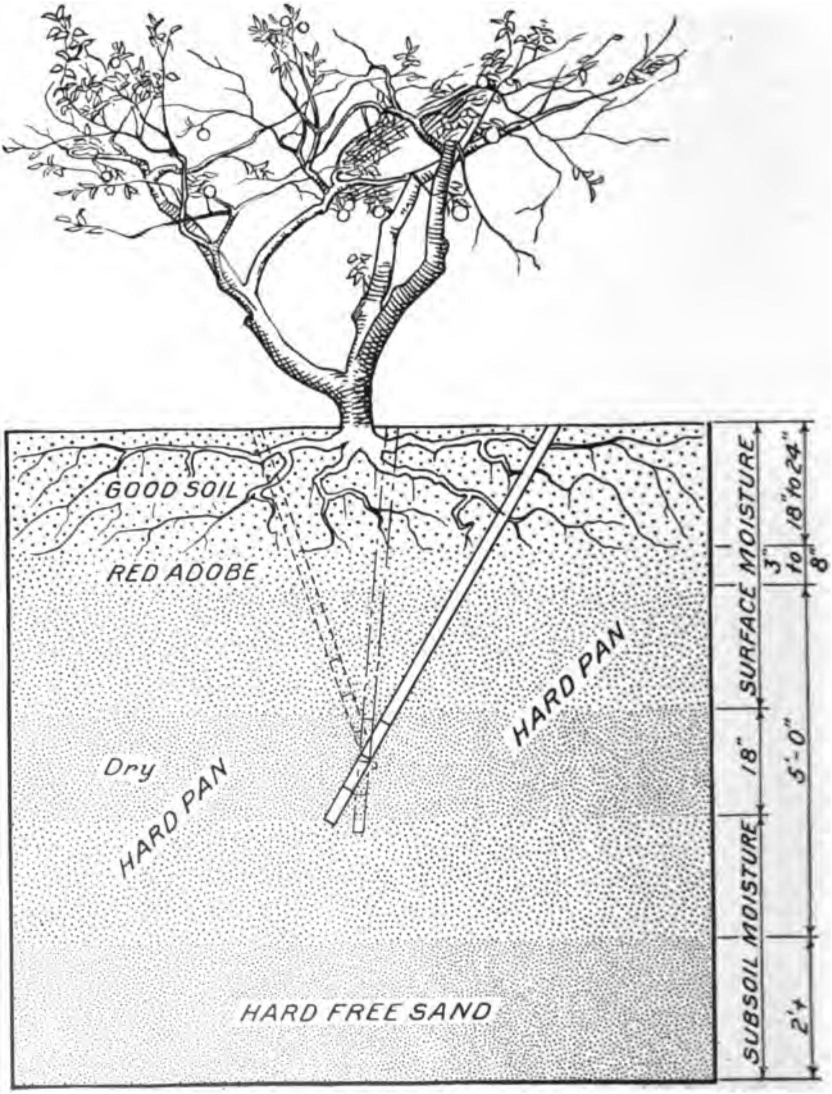


FIGURE 19

Cross section of California soil showing method adopted to rejuvenate an orchard grove.
(See page 27)

hardpan out of the immediate vicinity of the charge. The hole, thus made, we filled with manure, using a considerable quantity. We were satisfied very soon after the first work was done some ten years ago that whatever the cost, it was well worth the doing.

We have continued doing this work and at all times have been well repaid for the expense. Our success here with this work led us to shoot the ground where hardpan conditions showed up when planting the orchard, and our success with that has led us to shoot the soil wherever it could not be easily penetrated by the root system of the young trees.

Fifteen cents spent in this way in heavy soil, prior to planting of a young orchard and a larger sum used wherever hardpan conditions exist, will many times over repay the cost, whether in an old grove or in the planting of a young grove.

In an old grove it opens the soil and permits the water to go in in larger quantities, much larger quantities. It makes the root system of the trees penetrate to greater distances from the trees and to greater depths. In the young orchards it gives greater field for the young trees to spread out their feelers. The water will penetrate and distribute itself much more freely and much more effectively and in much greater quantities.

I do not hesitate in advising always, everywhere, to examine the subsoil conditions in any area about to be planted, in order to determine what conditions are to bs met and how to meet them. As a general thing, hardpan is not a detriment, it is easily shattered and the conditions easily controlled under our present methods of agricultural procedure. Do not hesitate to use powder—Dupont's—as you can find nothing better.

Yours truly,

JAMES MILLS, Superintendent.

Prevents Wilting Due to Hardpan

Mr. George Rounthwaite, of Riverside, California, writes:

The use of dynamite in our orange orchard has been a decided success. Our surface soil is of a fairly heavy red granite quality; grade for flow of irrigating water 6 to 12 feet in 660, trees set 21x22 feet apart. Gauge canal water, period or irrigation every 42 days with a head of 30 miners' inches continuous flow for three days and nights; 4 or 5 furrows between tree rows; 4 cultivations after each irrigation. Above data is common to this locality. February 20, 1899 (having been owner of property for two years), we found a portion of bottom of one 10 acres that was exceedingly hard to keep trees from wilting after 30 days from time water was applied. We found conditions of soil as per sketch enclosed. The majority of trees took three holes—with three cartridges of No. 2 Dynamite to each hole. Most of the holes were drilled with churn drill, though a few had to be drilled with hammer and all were slanted toward tap root as "lifters," as close to tree to work comfortably; fuses cut so they would not all go off together.

Results—Very few roots were broken, a hole opened at surface of not over 18 inches in diameter. Cracks in ground radiating from hole 20 feet in length from 1 inch wide to 0. A slight singeing of leaves from fire. After treatment, holes cleaned of hard red adobe and alternate layers of well-rotted stable manure and surface soil filled in.

Water was then run into holes, some of them taking 10 inches for 24 hours before filling, and since the summer of '99 have had no further trouble from trees wilting. Have not done any more blasting but am sure that at least one hole blown about equal distance between trees would be of further benefit. The cost of doing above work in 1899, for powder, labor, manure, etc., was 76 cents per tree.

I am of the opinion that the question of keeping up the activity of the older orchards is not all one of water and fertilizers. As a great many groves or portions of them show hard strata that do not permit the free circulation of moisture in sub-stratas, we would never be affected with an excess of sub-moisture as we are too high up on Mesa, so drainage would be O. K. I am also sure that a great many cases of gum disease are caused by the want of proper circulation in sub-stratas, which causes the water to stand around roots and sour same, setting up the disease.

EDITOR'S NOTE: Although we do not advise blasting holes under growing trees, believing that we can accomplish just as good results by blasting holes between the rows of trees, we think Mr. Rounthwaite should be given due credit for his original ideas on helping orange trees by breaking up hard stratas under them.

For Shade and Ornamental Trees

Oftentimes dynamite is more necessary in the planting of shade and ornamental trees than for fruit trees. The fruit grower generally has more latitude in the selection of the location of his orchard. He may plant in one field or another as best suits his purpose, but ordinarily the locations of ornamental and shade trees, shrubbery and hedges are brought about or fixed by the locations of buildings, parks, etc. In such cases, adverse soil conditions must be conquered since they cannot be avoided. Sometimes these adverse soil conditions will have been caused by grading, in the process of which all top soil may have been removed and the trees thus forced to live on recently exposed subsoil material. In other cases rock and hardpan may be underlying the logical locations of trees and these undesirable conditions must also be remedied. In cases of this kind blasting holes with dynamite, if the trees are to be planted, or blasting between the trees to rejuvenate them, if they are already growing, may prove very efficacious.

In planting trees on poor soil it is advisable to blast a larger hole than would ordinarily be required so that fertilizer may be deposited below the roots and the roots themselves surrounded by good top soil with which the hole may be filled. Dynamite is especially valuable in preparing holes of this kind.

In planting ornamental hedges it is advisable to blast a ditch along the line where it is intended to plant the hedge. This may be filled with rich top soil mixed with such necessary chemical fertilizers as may be required (depending, of course, upon the condition of the soil) and thus avoid having straggly, poorly developed hedge rows.

Grape Fruit Growing With the Aid of Dynamite in Florida Orchard of H. M. Flagler

This grove is located ten miles south of Miami consisting of 80 acres of land on which are 8000 young healthy bearing grape fruit trees of the best varieties.

The preparation of the land for this grove was commenced in 1905 and the trees were planted out during the same year. The land is high rocky pine land with only a small depth of soil or humus as surface soil and underlaid with a coraline rock basis containing about 87% limestone, which is prevalent throughout that section, and in furnishing the roots of these grape fruit trees the natural and easy growth which is necessary dynamite proved extremely satisfactory and most inexpensive.

The process entailed the boring of holes a few feet down and the exploding of dynamite at tree planting distances which loosened the earth sufficiently for good cultivation. After the soil is prepared to this extent, all that it requires is fertilization, which is an essential element incidental to the growing of citrus fruit in all sections, which is applied, as a rule, about twice a year.

This is the first year that the Kendal grove has borne any crop of consequence, the yield amounting to 4300 boxes, which is excellent considering the age of the grove. Next year the crop will approximate 15,000 boxes and put the grove at the advanced age which will guarantee large and profitable yields.

> The above was received from Mr. J. E. Ingraham, Vice-president of the Florida East Coast Railway, St. Augustine, Florida, under whose supervision the Kendal Grove is conducted.

Planting Walnut Trees in California

I planted 100 walnut trees this year with explosives and they have already grown larger than those I planted the year before where I did not use any powder in digging the holes. The powder beats anything I ever saw for making the trees grow fast. My land is mixed with sand and it is mostly black loam. I drilled my holes seven feet deep and then put in a half stick of Hercules No. 2, 40% and a handful of Champion and tamped the holes tight. After the explosion you could shove down a stick to a depth of ten feet, and I do not figure my cost over 20c. per hole. It would cost many times as much to dig them by hand and then the holes would not be half as good as those dug with powder. I have been using powder for many years, but never before for tree planting, but hereafter all my trees will be planted with powder, as there is nothing like it.

JAMES GRUBB,
Tudor, Sutter County, Cal.

French Prunes Do Well in Blasted Holes

SARATOGA, CAL., Sept. 17, 1911.

Gentlemen:

My experience with dynamite in an orchard has been confined to removing diseased and dead trees and opening holes to plant new trees. I have found this method much more rapid and hence much cheaper than by digging. It also leaves the soil in ideal condition for planting the new tree.

There was a block of five trees that had been replanted each year for four years, without getting one to grow. Last fall the holes were dug as usual and in the bottom of each hole we exploded a stick of Hercules No. 2 (40%) Dynamite. The trees (French prune) that were planted in these holes last winter are the strongest testimonials to the value of this process that could be offered, sending out new shoots six and eight feet long. In planting young trees in virgin soil the same results have followed, as it so thoroughly loosens up the hard ground that the young roots have every opportunity to start, causing the tree to make a vigorous growth the first year, which is most essential to the value of the tree.

Yours truly,

GUY U. SMITH,

State Assemblyman, 36th District.

Saves Dying Orchard By Blasting

CHERRYDALE, VA., February 15, 1912.

I noted on one or two occasions articles appearing in current magazines and paper on the use of dynamite in breaking up subsoil and cultivating in general, especially in orchards. I set out a small orchard a few years ago with rather unsatisfactory results, owing to the fact that there was a hardpan that ran in this section of the country under the top soil at the depth of two or three feet, which in rainy weather allows no moisture to penetrate, making the ground soggy for the time being; and then during a dry spell, with no moisture obtainable from beneath the hardpan, it is only a matter of a short time before the ground is as dry as a bone.

On reading the above mentioned articles I immediately made up my mind to give dynamite a trial, for the trees were practically at a standstill for the past three years and I knew it could do no harm, and I must say that I am more than elated over the results. Where I replanted trees I had an opportunity to place a small charge to loosen the top soil down to the hardpan, and after cleaning out the same I drilled through the hardpan and broke that up nicely with another small charge. The trees planted in this manner are running away from the rest, and at the same time those trees that I simply cultivated with dynamite have shown marked improvement over those that were simply worked the old way. Although I have had only one season to observe these results, I really expect better results from now on.

I may add that the time and labor saved is by no means a small item. By using dynamite, I simply had to ram the bar down about two feet, place a small charge, which cost less than two cents, and was sufficiently strong enough to puff the ground up and around a reasonable distance. With such gratifying results it makes a fellow feel bad when he thinks of the labor and time spent the past three years working around trees the old way, and I assure you from now on it will be dynamite for mine.

Very truly yours,

PAUL C. BISCHOFF.

Plants Six Hundred Acres of Citrus Fruits With Dynamite For $6.00 an Acre

WOODLAKE, CAL., June 30, 1911.

During the past three years we have set out six hundred acres of lemon and orange trees and in every instance have used a stick of your dynamite (Red Cross) in the hole where the tree was planted. The trees are all healthy and doing fine. There is a very marked difference between the trees that were set in this manner and those not dynamited.

In using this dynamite we bore a hole three feet with a two inch auger at a cost of about two cents per hole, which, with the cost of the dynamite and the labor in exploding same for ninety holes per acre, is about $6.00 per acre. There is no other manner by which the ground can be prepared so well for planting at this cost.

WOODLAKE ORCHARD CO., By G. F. Stevenson.

Dynamite-set Trees Show 300% Better Growth

SHENANDOAH VALLEY APPLE LANDS COMPANY.

WAYNESBORO, VA., October 17, 1911.

I took our orchard development foreman out to the fields where you were making the demonstration of tree planting with dynamite last April. My foreman saw at once the merits of your method in planting and we followed your instructions in setting 2,000 apple trees with the following results:

The 200 trees that we planted in the old method of digging the hole with pick and shovel came through the growing season, a very dry one, with an average growth of about six inches. The 1,800 trees that we planted with your Red Cross 40% Dynamite today show an average growth of eighteen to twenty-four inches, and they are the strongest, most vigorous young trees out of the 6,400 I have inspected during the last month, and on referring to our planting records, I find that the cost of planting with your dynamite is considerably under the cost of the old method of digging the holes.

We are very well pleased with the results obtained from Red Cross, both as to cost and results, and I was surprised to see how readily our men learned to use this dynamite and how proficient they became with a little practice; we had absolutely no injury and I find the old idea that dynamite is dangerous to handle is all "bunkum."

We are planning to plant 4,000 apple trees next spring, and we want you to send any "doubting Thomas" up to our orchard to see this work done.

H. H. MAGIE, Secretary.

From a Professor of Horticulture

BOZEMAN, MONT., Oct. 3, 1911.

I have been very much interested in the work which you are carrying on to demonstrate the value of dynamite upon the farm, but I am especially interested in the use of this material in planting trees, both as a means of digging the holes and as a means of shaking up the subsoil.

It has been intimated by some that the fruit trees in some of our irrigated sections are shallow rooted, and it is no doubt true. Two conditions are met with in arid sections, which I believe do induce fruit trees to root shallow. One is a hard subsoil, through which the tree roots are unable to force their way. This layer of subsoil is often thin and could easily be shaken up with dynamite. Once the roots of the young trees are through this soil, they would find conditions for growth good below this hard layer, commonly referred to as hardpan.

Another condition, which is just as frequently responsible, I believe, is a dry subsoil which does not invite the growth of roots in that direction. In these arid regions many of our young orchards are planted upon raw land. The subsoil is naturally very dry; and, if the soil is rather fine, it may be several years before the irrigated water applied will reach the depth to which tree roots normally go. But until the moisture is there, the roots will seek the surface soil where the moisture supply is plentiful. And when once the tree has established this shallow system of roots, it does not change.

The use of dynamite in planting would, I am sure, break up the subsoil and allow the irrigation water applied the first season to rapidly settle to the lower soil and attract the roots of the young trees in that direction. The roots well down in the soil are away from fluctuating temperature and moisture conditions and are better able to serve the tree.

O. B. WHIPPLE, Horticulturist, Montana Agricultural College.

A Director of Agriculture Convinced

SACRAMENTO VALLEY IRRIGATION COMPANY.

During the past week your Messrs. Jones and Doremus have given the farmers of Glenn County a very fine demonstration of the use of dynamite in farming.

There is no question but that hundreds of pounds of your Red Cross Dynamite will be used here during the next year as a result of the work of your representatives.

While there is no hardpan through this section of the west side of the Sacramento Valley, the loosening up of a big body of soil in land where trees are to be planted will give the tree roots a perfect environment for growth and development, and be of great value. The opening up of lands that have been pastured when wet and otherwise abused will be accomplished by the use of dynamite in a very effective manner. Your work here is appreciated.

W. S. GUILFORD,
Director of Agriculture.

Orchard Manager Proves Value of Dynamite in Tree Planting

STAUNTON, VA., August 14, 1911.

While I had been a firm believer in the use of dynamite for this purpose, I had never had an opportunity to make a practical demonstration of it until during the planting season of last spring, when, acting as manager of the Pell-View Orchard Company, near Fishersville, Augusta County, Va., I undertook to set some young trees, and determined to use dynamite in blowing the holes. I had several varieties of soil, a portion of which was underlaid with rotten slate, and after staking out the orchard, I used from one-third to one-half stick of dynamite planted three feet in the ground for blowing the holes. I used an ordinary steel and hammer, and in many instances a hand crow-bar, for putting down these holes, and after capping and fusing the piece of dynamite, we tamped it well in the ground and found that it broke up the clay subsoil, and where it came in contact with the rotten slate, the slate, oftentimes as deep as five feet. I found upon investigation that the soil itself was broken up two or three feet around, so that there was absolutely no difficulty in digging the holes for the trees.

I used a small boy with a shovel, and found that he could clean out the hole, throwing the dirt to one side, with the greatest ease, and did it very fast. Very little of the dirt was thrown up or left above the surface of the ground. The concussion makes little noise, and if handled carefully, there is practically no danger.

We planted the trees late, in the very beginning of what has proven the most protracted and serious drouth I have ever known in this locality, and it has been particularly hard on young trees.

The part of the experiment, however, which interested me most, and which I think was of practical and beneficial result, obvious to anyone, was that after planting the trees it was noticeable that from two to three feet from the trunks of the trees the ground was distinctly damp. We used, of course, the topsoil only to fill in with, which was tamped well, and while the drouth was distressing to the balance of the land, and without having a particle of rain, it could be observed with the naked eye, and upon closer investigation, that the ground around the trees was moist and damp. A gentleman interested with me, who did not approve of the use of dynamite because of the expense and the fact that it seemed experimental, observed this fact, and suggested to the foreman that my attention be not called to it, saying that if I observed this I would certainly dynamite the whole orchard.

I contemplate planting some fifteen hundred young trees this fall, and will most certainly use dynamite.

I might add that in placing a hole, if I found rock near the surface, I used oftentimes a whole stick of dynamite, which would generally do the work very effectually.

WM. A. PRATT, Manager,
Pell-View Orchard Co., Inc.

California Hardpan Conquered

OMEGA BRANCH
GROWERS OF SEQUOIA BRAND FANCY FRUITS AND GRAPES.

DINUBA, CAL., October 7, 1911.

The trees planted last spring, for which the land had been dynamited, are doing exceptionally well, in fact, much better than I expected. The demonstration you gave convinced me that the value of Du Pont explosives cannot be overestimated. My land had a heavy stratum of hardpan at an average depth of one and one-half feet, and under this hardpan was a very good and sub-irrigated subsoil. After blasting the holes and planting the trees this spring they have not had one drop of water, either through irrigation or rainfall, and now they are in very fine condition.

Z. M. DICKEY, Manager.

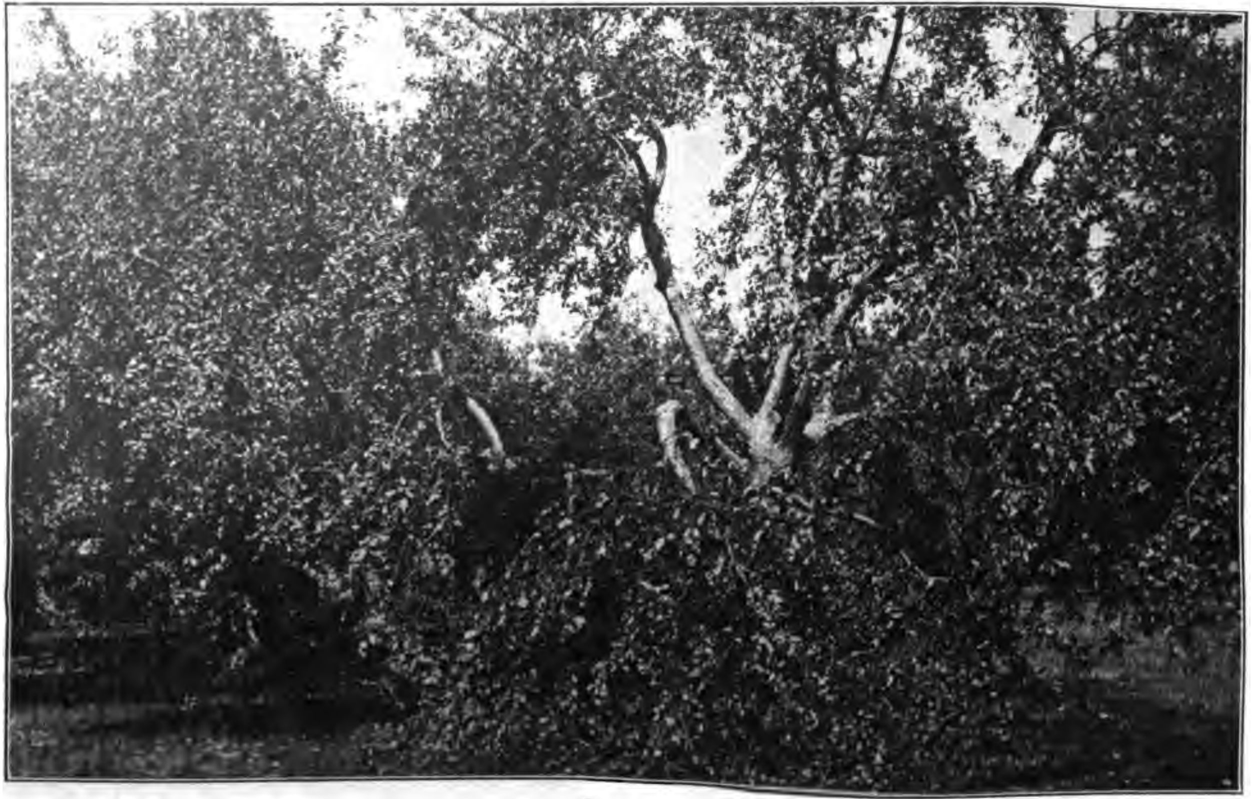


FIGURE 20
One of E. P. Edwards' 60-Year-Old Trees (See page 24)

General Advice on Tree Planting

Setting Trees With Dynamite to Conserve Moisture

ARTHUR E. COLE, Prop., High Point Farm and Nursery, Chamblee, Ga.

Over a large portion of our country is a hardpan of shale or tight clay near the surface. It is a menace to the productiveness of trees and all vegetables which root deeply. The scientific principle involved is the inability of such a subsoil to absorb, retain and give back to growing crops the essential moisture. On such land, the water soaking through a thin topsoil fails to penetrate and finds a second drainage on this sub-surface, draining off in "Wet Weather Springs" or standing in surface suspense as "Bogs." Land in this physical condition fails of an agricultural dividend. Put in proper physical condition this same land becomes highly profitable. The way to proceed is by using dynamite. Probably no process of plowing known to agriculture can produce the good results in breaking up a tight subsoil that does this blasting with Du Pont Dynamite.

Planters of clover and alfalfa realize this. Orchardists have come to accept it as final. Strawberries and all crops requiring a great amount of moisture respond to its use in a way almost unbelievable. Short lived crops like tomatoes and cucumbers will continue to bear through the long season where the hills are shot with cartridges of dynamite. Figs produce a crop the first year after being set where dynamited. The writer can see this from his back door as he writes. This new-found process is the foundation of a new era in agriculture and horticulture. It is the horticultural application that this article aims to emphasize.

At the present time many thousands of trees are being set in young orchards all over the United States. Such a boom in apple and pecan planting was never before known. It is a logical answer to an unsupplied demand. The question is, will these orchards endure—will they pay? The answer rests largely with the mode of setting.

In orchard setting, the use of dynamite is advised in practically all soils. The pecan naturally flourishes on the deep, moist, alluvial soil of river and creek bottoms. Nature has put it where it will not suffer from drought in the long, hot, dry summer and autumn through which it must hold and mature its late fruit. We can move it to our grove or back yard and succeed with it by conserving the moisture by dynamiting the ground.

The method of dynamiting follows under discussion of apples.

Watermelons and peaches should be dynamited because they require great moisture, being fruits composed largely of water, but of all fruits demanding an unfailing and continuous supply of moisture the apple and pecan lead. Therefore, it is imperative that we dynamite as an artificial means of conserving the moisture. Unlike all other fruit, the apple grows on the end of a twig of new wood, a twig which bears no more. The apple being a biennial, sets its fruit bud for next year during July and August of this year. So we see this hard condition imposed: a winter apple must make its new growth of wood, hold its foilage, mature its present crop of fruit, and, if it is to produce again next year, the little tender twig bearing an apple must mature a new fruit spur or twig alongside of it to bring forth a healthy fruit bud next year. And all this during a long, hot summer or autumn. The demand for moisture is enormous.

What if the tree is shallow set? What if the roots trail along close to the dry surface? What if the tree is on a dry ridge or hillside baked by the summer sun? What if on thin land, starved for both fertility and moisture? The answer may be total failure or partial failure and short lived trees, or a partial crop, or a crop only every other year, or a large per cent. of drops, or defoliated trees. READER! Observe and mark well. Your orchard dividend and its future success is in balance when you *set* your orchard. Remember you can never set it over the second time. No amount of regrets can retrive a mistake made in the setting. You will spend much money bringing your orchard to a high standard by the allotted time for it to begin to bear, but no amount of money expended in after years can correct a mistake at planting time. You may have in mind plowing out a deep furrow for your row, but remember that that furrow can never be plowed again, and the root system will be influenced to confine its growth to the small amount of pulverized soil. Holes may be dug, broad and deep, but like a large plant in a small pot, the hard walls of the hole when filled with roots will cramp or turn back or callous. In either of these methods the orchard dividend will be found wanting.

The new and eminently successful mode of land preparation for all fruit or ornamental trees and for many field or garden crops, especially in tight, dry soils, is by blasting holes with half cartridge of Red Cross 40% Extra Dynamite or blasting the furrow with a like amount at intervals of 15 to 20 feet. If in a large orchard or a large field, a blasting machine may be used to detonate the charges. If only a few trees are to be set, the blasting should be done with fuse and blasting caps. Let the depth of the holes for setting your cartridges be governed by the state of the soil. Make a hole with auger, sharpened wood dibber, or crowbar well down into the subsoil. Tamp well with moist clay. For the best results, throw out a bushel or more of the clay that has been broken by the shot and fill with some organic matter that will slowly decompose as the years go by, mixing and cutting in well with a sharp shovel or spade. Leaf mold, woods topsoil, fence corner settlings, old bones, scrapings from under an old house or outhouse or any such matter is good. Now the roots can go down and out in an area broken and pulverized for many feet on all sides. The tree will make a rapid and healthy growth and come to bearing earlier and live many years longer. It will produce fruit annually, more fruit, larger fruit and fruit of better color because of the conserved moisture. It will resist drouth. The much talked of "insect resisting tree," is not a tree immune from insects, but a tree healthy and vigorous enough to overcome their baneful attack.

The writer set an apple orchard last winter, using Red Cross 40% Dynamite, in an area where wooly aphis is known to abound; but not a single evidence of their presence has been noted. This is a reverse of every instance of a young orchard in that section, set in the old way.

The winter, spring and summer just past is one of the dryest on record for Georgia. Many trees, in fact a large per cent. of trees, set by the ordinary method have died. But in three orchards set by the writer with dynamite, 100% are living and doing well. As a neighboring nursery man expressed it, "These trees didn't know it had not rained."

It is to be hoped that in tree setting we have learned "That a stick in time saves nine."

The Proper Way to Set a Tree

Some Advice on Tree Planting from the Booklet of a Prominent Nurseryman

A. Good fertile topsoil must be used about the roots. If the tree is to be planted in impoverished ground, good soil should be provided for it.

B. Plant a tree just as deeply as it stood in the nursery row. This depth is very easily determined by the dirt line always shown at the bottom of the trunk. *Failure to plant in accordance with this rule probably results in the loss of more trees than any other cause.*

C. Before planting cut off all the broken or bruised parts of roots.

D. Be sure to press earth firmly about the roots, especially about the crown, so that every particle of the roots will be embedded in compacted soil.

E. A tamping stick may be used to work the soil firmly about the roots. With small trees and plants the dirt will settle firmly, if the plant is gently lifted up and down, when the hole is half filled, so that the dirt will work its way between the roots. Just before filling in all the dirt press it firmly. *Be sure that the dirt is well compacted, excepting* three or four

Sometimes in blasting a hole for a tree a small pot-hole is formed below the bed upon which the tree roots are to rest. If this hole is permitted to remain, the earth will, in the course of time, settle away from the roots and the tree will die. To avoid this poke into the earth with a sharp pointed stick at the point where the blast has taken place and thoroughly settle the loosened dirt into any pot-hole beneath, which may have been formed.

G. Trim broken or bruised branches, also two-thirds of the previous year's growth; because the roots in their disturbed condition cannot at the outset nourish as large a top growth as before they were disturbed by moving.

H. It is often best not to trim the leader or central stem, as a forked tree may result. Hardwood trees, like the oak and beech especially, should not have their central leader trimmed.

I. If the tree is large or in an especially exposed place where winds may loosen it, support it with wires and provide some protection where the wires come in contact with the tree trunk. A piece of burlap with a few sticks are useful to prevent the wires chafing the tree where they come in contact with it.

J. After planting, it is better to leave a cultivated arear about the tree than to sod close to it. This cultivated area should be from three to five feet in diameter.

K. Fertilizer, in the form of stable manure or compost, may be used, but should not come in direct contact with the roots. A mulch applied after the planting is usually the best way to supply this fertilizer, as it then also acts to conserve the moisture.

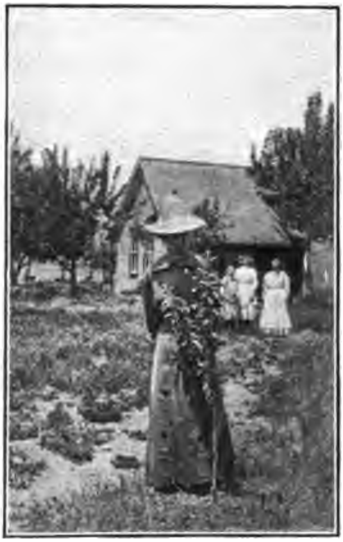


FIGURE 21

Two-Year-Old Apple Tree Set in Spaded Hole

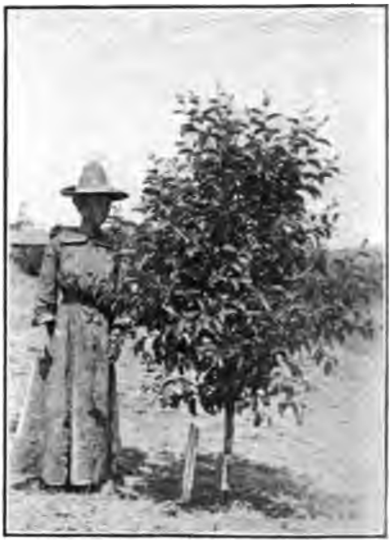


FIGURE 22

Two-Year-Old Apple Tree Set in Dynamited Hole

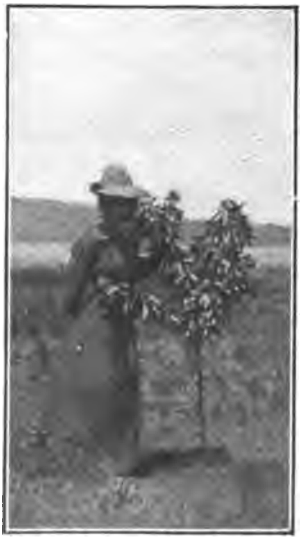


FIGURE 23

Bing Cherry Tree, Two Years Old, Set in Spaded Hole

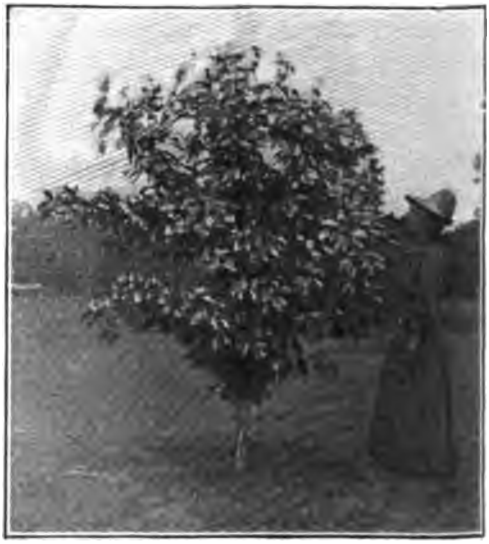


FIGURE 24

Bing Cherry Tree, Two Years Old, Set in Dynamited Hole

Proves Efficiency and Economy of Dynamite

GRANTS PASS, OREGON, May 12, 1911.

Gentlemen:—I am sending you photographs of four trees.

Figures 21 and 22 are Bellflower apple trees; Figure 21 was set in a spade-dug hole, and Figure 22 in a dynamited hole.

Figures 23 and 24 are Bing cherry trees; Figure 23 was set in a spade-dug hole, and Figure 24 in a dynamited hole.

These four trees were part of a shipment of year old nursery stock received and set out the latter part of March, 1909. The photographs were taken about the 15th of April, 1911, two years after setting out, just as they were coming into leaf.

Bellflower apple tree (Figure 22) was pinched back in June, 1909, about ten weeks after planting. It was shortened in by removing some two feet of growth from each main lateral the following November. In 1910 it had the same treatment. It is a very vigorous tree with healthy foliage and fine color.

Bellflower apple tree (Figure 21) had as good ground to grow in, but was spade-set and made such small growth it needed neither pinching back nor pruning. Not a bit of growth, not a leaf has been removed from the head of this tree since planting. The trunk is less than half inch in diameter, while the dynamite-set mate to it has several branches thicker and finer than the trunk of Figure 21.

The Bing cherry trees (Figures 23 and 24) have the same identical history as Bellflower apples (Figures 21 and 22) with the exception that we did not shorten in at fall pruning (Figure 24) as much as we did apple No. 22.

We have heavier tops and taller trees of these varieties in the orchard, but these trees are two favorites, very typical of their kind and strike a favorable average for the lot of five hundred. From 250 apple trees so set we got a perfect stand, not one died.

We use dynamite for making holes in planting trees on our very best and deepest ground, as well as the poor spots. It is much cheaper than hand labor, it is much quicker when speed is a most important point and delay will cause the loss of many trees. It insures every advantage to the tree getting a good start.

After the orchard is staked, one man with a shovel removes a circle of surface soil from about the stake, usually five cuts or so, which is laid to one side to use in filling the hole to proper level before setting the tree with the roots carefully pruned back.

A second man follows the first with a crow bar and works the hole down where the stake comes out. If a stone or anything of the sort is encountered we dig it out. If a spot of hard sediment or hardpan is encountered the hole is put through. These holes are about eighteen inches deep. We use one stick of dynamite properly fitted with 18 inches of best fuse for the average hole. It is dropped to the bottom of the hole and tamped down, then the fuse is lighted. There is very little stuff thrown up, the force going downward and outward. The holes are allowed to stand probably over night, or part of the next day, are probed with a crow bar, and, if satisfactory, the sides are broken in, the top earth at one side filled in, and the hole is ready for the tree.

We have set all our trees in wet weather, which insures a storage of moisture under the tree. If one were compelled to set in dry earth, a generous supply of water should be added to settle the hole prior to throwing on top earth that makes the bed for the tree to set on. Twice each spring a circle should be worked up to a fine mulch about the depth of a spading fork, and kept loose, unbaked and free of weeds.

Last November we had occasion to remove some filler trees, Grimes, Golden apples, seven months after setting out, one of which was spade set. They were taken up with the greatest care so we could get the roots out intact just to prove to ourselves what difference in root growth we would find in same variety, in perfectly matched trees on the same ground from the two methods of setting.

The spade set tree had a fine bushy and vigorous tassel of roots about a foot long. The dynamite set tree had two roots going down some three feet. I held it out at arm's length, my hand clasped around the graft scar, and the roots touched the earth. Also it had a great quantity of medium and short growth roots. The difference was so convincing that we now have thirty acres of new orchard and every tree is set with dynamite.

You will probably be amused at my zeal, but I used half sticks of dynamite in making up a rose bed, and also for a hardy border set with peonies and other perennials. Am happy to say the peony plants are now ready to bloom profusely their first season, although, hitherto, I have failed to bloom them before the second or third year.

We wouldn't undertake to clear ground or set new trees, shade or orchard, without using dynamite, notwithstanding our soil is a beautiful loam, with little stone in it, and runs from five to six feet deep.

MRS. JOHN RAWLEY.

A Help in Dry Farming

GOODPASTURE, COLO., December 16, 1911.

It gives me pleasure to add one testimonial for the use of dynamite for the blowing of tree holes.

Many years ago I saw a farmer using this on a portion of irrigated ground that he could not dig with a spade, and these few trees did much better than where the holes were dug. The thought occurred to me if this was good for irrigated ground, it ought to apply to non-irrigated, so I thought I would give it a test. I dug my tree holes 2 feet in diameter and 2 feet deep, drove a drill in the bottom of this hole about 24 inches (and by tapping the sides of this drill, it can be easily pulled out). I used about two-thirds of a stick of dynamite which opened the ground many feet.

The cost of dynamite for these holes was about 10 cents each, and the land is of such a nature that it would have cost ten times that much to dig these holes by hand. I also planted a few trees, in spade-dug holes. These trees have died, while the fruit from the trees planted in dynamite-dug holes won a world's prize.

My first planting of trees by this method of dynamiting and thorough cultivating was 180 apple trees, set in the Spring of 1904, and I have only lost one and that was killed by the rabbits. Have planted many trees since by this method with good results.

Trees begin to bear the second year and look as well as irrigated ones. They are the world's record breakers. I indorse the use of dynamite and you may use my name in your advertisements.

LEE R. ROPER.

Lemon Grove Improved

CORONA, CAL., October 14, 1911.

I am working upon the strip of orchard which was shot last fall and I find a marked improvement in the appearance of the lemon trees.

It is my intention to continue this work of blasting until I have treated all portions of our orchard where the conditions of the trees indicate the existence of a hard formation under them.

W. C. McCULLY, Manager El Cerrito Rancho.

Good For Shade Trees Too

THE C. V. NURSERIES
ORNAMENTALS AND SHADES FOR PARKING OUR SPECIALTY
LANDSCAPE PLANTING.

BLACKWELL, OKLA., October 16, 1911.

During the past five years we have planted 2,500 shade, ornamental, and fruit trees, all of which were set in holes dug with Red Cross Dynamite.

The cost of dynamiting these holes would be about 10 cents as compared with a cost of 25 cents had the holes been dug by hand.

During this time we have planted some trees in spade-dug holes, and comparison shows that those set in dynamite-dug holes are much superior, and stand the drouth better: and while we have not had an opportunity to make close comparison of the individual pieces of fruit produced on the trees set in dynamite- and spade-dug holes, it is our opinion that the fruit on the dynamited trees is much superior.

In planting a number of trees the time saved when using dynamite is a valuable feature; and during this Fall and next Spring it is our intention to set out a great many more trees, and dynamite will be used for digging the holes for planting most of these. Although we used dynamite in heavy clay soil, we really think it would be beneficial in all soils.

J. W. TETIRICK.

"Never Again" for the Spade

S. K. GARRISON, GROWER OF APPLES, PEACHES, PEARS, STRAWBERRIES.

CROZET, VA., November 7, 1911.

I am using your Red Cross Dynamite every day now; and have bought 250 pounds to plant 1,000 trees, and am getting along fine, and find it O. K. I shall never dig another hole for trees except with dynamite.

Several of my neighbors came around and I showed them the work. Then they bought dynamite to plant their trees with.

S. K. GARRISON.

Red Cross Dynamite is Best for Farm Work

Our many years of experience in the manufacture and use of explosives has taught us that if an explosive is to do its work at the lowest possible cost and produce the best results, it must be made with qualities especially suited to the work in which it is to be used. Red Cross Dynamite is particularly strong in those qualities necessary in agricultural blasting.

Red Cross Dynamite is safer to handle and use in farm work than other dynamite. A large majority of the accidents which happen when dynamite is used, occur in thawing it. Most dynamite freezes at a temperature ranging between 40 degrees Fahrenheit and 45 degrees Fahrenheit, but Red Cross Dynamite can be depended on to keep soft and in good condition in any temperature that will not freeze water. When Red Cross Dynamite is frozen, it can be thawed simply by burying the case containing the dynamite in a manure pile until the cartridge becomes soft.

When dynamite is frozen or even chilled, it cannot be properly exploded, and consequently does poor work. Most dynamite, except Red Cross Dynamite, will chill and lose value in a very few minutes in cold weather. Even when loaded in cold earth or rock it will chill in a very few minutes. This loss does not happen with Red Cross Dynamite because it will remain in perfect working condition for some little time, even in freezing weather, and it does not lose any power at all after it has been loaded in bore holes below the frost line.

Red Cross Dynamite is also less expensive than other dynamites.

Red Cross Extra Dynamites are made in strength from 20% to 60%. Because it is safest to handle and costs least, we especially recommend Red Cross Extra Dynamite particularly for all blasting about the farm, unless the work is very wet, in which case Red Cross Dynamite should be used. The only work about the farm for which Red Cross Dynamite is not suitable is ditch blasting in wet ground with blasting cap and fuse in the middle hole only. In this work 50 or 60 per cent. Atlas or Hercules Dynamite should be used and the blasting should be done in warm weather.

Get What You Pay For

The strength of all Du Pont dynamites is shown on the cartridges and cases with the exception of our Permissible Explosives and explosives having strengths of 20% or less. We guarantee the strength marking on cartridges and cases to be correct.

Anyone using dynamite the strength of which is not marked is probably getting less than the represented strength and is therefore paying too high a price for what he buys. Inferior goods, you know, can be sold at lower prices than standard manufactures.

Explanatory Note

Several orchardists who have read our Tree Planting Booklet have asked why it is that we recommend our Red Cross 20% dynamite for tree planting and orchard rejuvenation, when many of the orchardists who have given us testimonials, which are published in the Tree Planting Booklet, speak of having used 40% grade.

It is because the 20% grade has not been generally carried in stock by dealers throughout the country up to a very few months ago. The 40% grade has been more conveniently obtainable and hence more generally used. Of course, the 40% strength gives very satisfactory results in tree planting, but as our experiments have convinced us that the 20% grade is fully as good and, under most conditions, a little better and is cheaper than the 40% grade, we recommend it.

Safe Handling of Dynamite

There is a popular misconception of dynamite in the public mind. Newspapers in reporting outrages such as bomb throwing by anarchists, safe cracking "jobs" by burglars, etc., incorrectly report them as perpetrated with "Dynamite." The result is an erroneous, widespread impression that a dynamite cartridge will explode if dropped on the ground or thrown against the body of a person.

As a matter of fact, safe breakers and bomb throwers do not use dynamite cartridges at all; they would not be suitable for their purpose because it is so difficult to explode them. What these criminals use as a rule is nitro-glycerin. This dangerous explosive is used commercially for shooting oil wells, etc.

True there is a certain proportion of nitro-glycerin in dynamite cartridges, but the dangerous explosive is scientifically compounded with wood meal, and some other ingredients in such a way that it can be absolutely depended upon not to explode accidentally if our simple and plain instructions for its use are complied with.

One of the safest of explosives manufactured by the Du Pont Powder Company is Red Cross Extra Dynamite, which is especially recommended for agricultural purposes. This brand of dynamite, in practice, is detonated by the powerful shock of an exploding blasting cap or electric fuze, the strongest cap or fuze being necessary because this dynamite is so insensitive.

Responsible people can use and handle dynamite just as safely as they can handle gasoline, matches, or coal oil. The energy of dynamite can be directed in the work to which it is adapted as well as the energy of steam can be directed in the work for which it is used.

Instruction Book Sent FREE

If the foregoing pages have convinced you that explosives can be used to advantage on your farm, the next questions that will arise in your mind are: How are they used? How much do they cost? What quantities are needed? What other supplies or apparatus are needed, etc.? All these things are fully and clearly explained in our large booklet, "The Farmer's Handbook of Explosives," which may be obtained, free of charge, by cutting out and mailing card No. 1 printed on the inside back cover of this pamphlet.

We believe that when you have read the book, you will understand how simple and economical the use of Red Cross Dynamite is, and that you will find many ways to save and make money with its aid.

E. I. DU PONT DE NEMOURS POWDER CO.,
Wilmington, Delaware.

A-95
200-M
4-12

DRAINAGE
WITH
DU PONT
RED CROSS
DYNAMITE

110 FOOT DITCH BLAST, ELK GROVE, SACRAMENTO CO., CALIF.

DEALERS WANTED EVERYWHERE

We want a dealer in every city, town and village not already covered. We request any hardware dealer or general store-keeper reading this booklet to mail the Card No. 3 on inside back cover, if he would like to consider our proposition to sell dynamite and blasting supplies for agricultural or other uses.

* * *

PROFESSIONAL BLASTERS CAN FIND PROFITABLE EMPLOYMENT ON FARMS

Threshermen and others doing farm work of various kinds at certain seasons of the year can obtain much profitable employment from farm owners by learning to do blasting for farmers that do not wish to do it themselves. We take pleasure in instructing any man in methods of doing the work. For information on this subject, fill in and mail the Card No. 2 printed on the inside back cover.

THE LORD BALTIMORE PRESS, BALTIMORE, MD.

Reclamation by Drainage

The First National Drainage Congress met in Chicago December 9, 1911. Among the facts presented were the following:

That there are in the United States more than 75,000,000 acres of swamp land that are non-productive.

That the drainage of this land will reclaim it for agricultural pursuits and add several billions of dollars to the wealth of the nation.

The location of these reclaimable swamp lands and their approximate areas are shown in the table below:

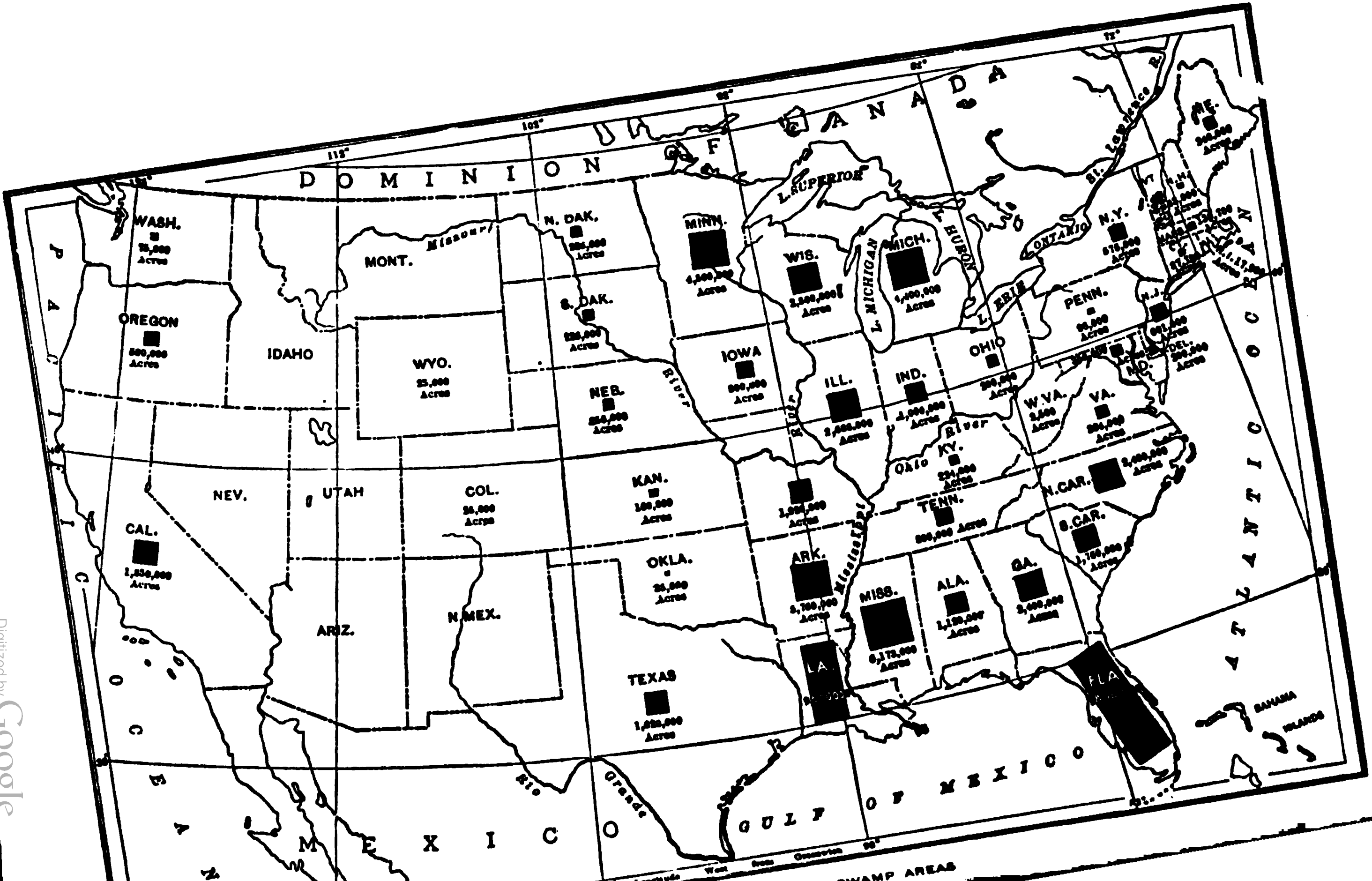
	ACRES
Alabama	1,120,000
Arkansas	5,760,000
California	1,850,000
Connecticut	37,700
Delaware	200,000
Florida	18,500,000
Georgia	2,400,000
Illinois	2,688,000
Indiana	1,000,000
Iowa	800,000
Kansas	160,000
Kentucky	224,000
Louisiana	9,600,000
Maine	240,000
Maryland	356,000
Massachusetts	138,700
Michigan	4,400,000
Minnesota	4,500,000
Mississippi	6,173,000
Missouri	1,920,000
Nebraska	256,000
New Hampshire	43,000
New Jersey	601,900
New York	576,000
North Carolina	2,400,000
North Dakota	226,000
Ohio	200,000
Oklahoma	35,000
Oregon	500,000
Pennsylvania	96,000
Rhode Island	17,900
South Carolina	1,760,000
South Dakota	226,000
Tennessee	800,000
Texas	1,620,000
Vermont	70,000
Virginia	384,000
Washington	75,000
West Virginia	2,500
Wisconsin	2,500,000
Wyoming	25,000
Total	74,541,700

A writer in a Southern publication gives the following interesting information regarding the swamp areas of the United States and the value of these areas if they were drained:

"The latent wealth in 10,000,000 acres of reclaimable delta and overflow lands of Louisiana is so much greater than any discovery of mineral wealth in gold deposits that was ever made that it is hard to make a comparison. If that land were reclaimed, settled and cultivated, with a settler and his family on every ten-acre farm, it would yield every year food products that could be sold for gold aggregating a thousand million dollars a year. And if it were known that along the marshes of your coasts and under the waters of your bayous there was $1,000,000,000 contained in gold deposits of some form, you would have a gold rush from every part of the world that would bring greater multitudes to your state than the gold discovery of 1849 took to California.

"There is no place in this world where such latent possibilities of agricultural wealth exist on such a stupendous scale as in Louisiana.

"This whole question of land reclamation or drainage is of enormous importance nationally. There are estimated to be 74,541,700 acres that can be reclaimed by drainage and it is scattered through forty states."



U. S. MAP SHOWING RECLAIMABLE SWAMP AREAS

Col. Will L. Sargent, traveling immigration agent of the joint Texas and Louisiana Immigration Bureau, is another enthusiastic believer in reclamation by the drainage process and has spent a great deal of his time studying land conditions, soil possibilities, the results of reclamation, the crops that are produced after the land has been reclaimed and every other phase of the subject.

"The reclamation, by drainage, of our wet lands will produce better health," declared Col. Sargent, "and if the 74,000,000 acres in the United States were reclaimed and divided into 40-acre farms there would be added 1,850,000 new farms. And if each farmer spent $350 per annum the purchasing power of this class of farmers alone would mean $647,500,000 that would go into the various channels of trade, etc."

Continuing further along that line, Col. Sargent said: "Estimating five persons to the family for each of the 40-acre farms, the agricultural population of the United States would be increased 5,550,000. Under intense cultivation these lands could be made to produce, at a most conservative estimate, $50 per acre, or $3,700,000,000, as an additional production of wealth which would be distributed throughout the country.

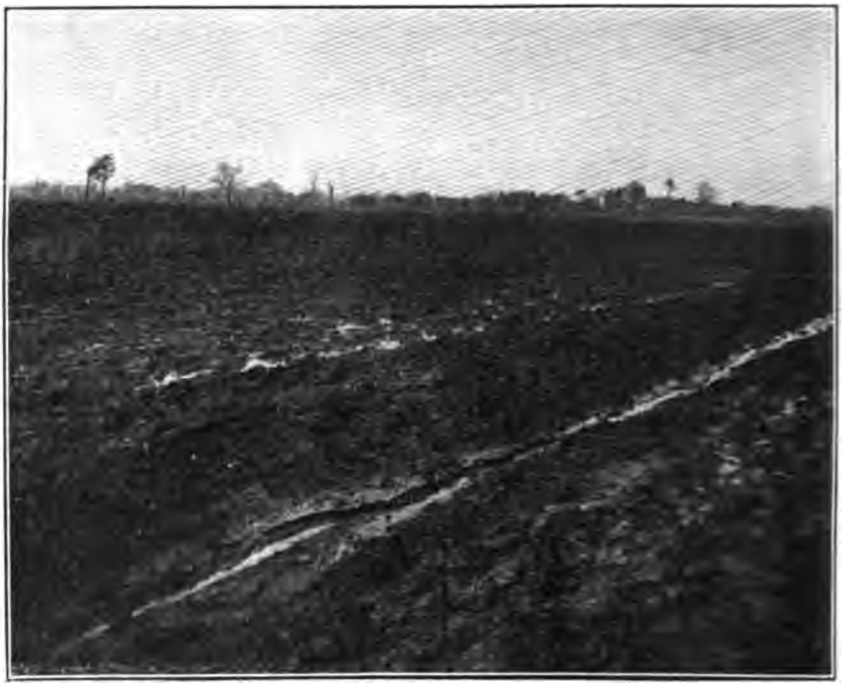
"The federal government places the cost for draining at from $2 to $30 per acre. Let us place the average cost at $25 per acre, and you will find that the total cost for reclaiming the 74,000,000 acres would amount to $1,850,000,000. Any drained project, if served by transportation, judiciously managed, will yield a much larger profit as an investment than almost any other line that is conservative that one can engage in. Besides, it is a safe investment.

"The cost of drainage, as compared with other work of improvement, is small," continued Col. Sargent. "The average cost of the reclaiming of arid and semiarid lands for irrigation in the western part of the United States, which is done by the federal government under the Cary Act, is about $36 per acre, some projects costing as high as $100 per acre. It is a safe conclusion to say that a person can acquire at least two acres of drained land for the cost of one of irrigated lands. Besides the greater portion of the lands subject to drainage already have, or there are nearby, transportation facilities as well as settlement, which is seldom the case with irrigated projects."

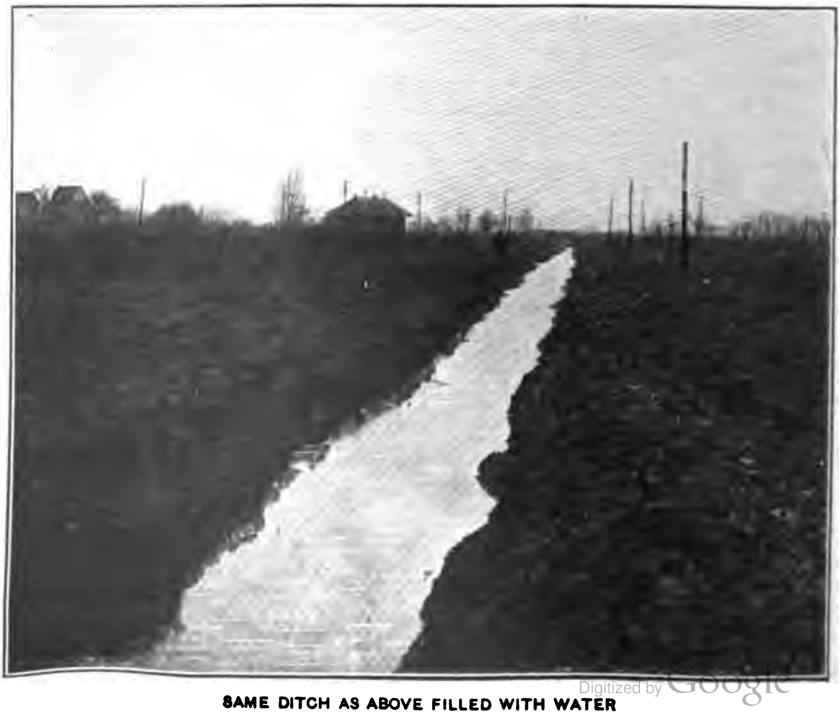
"If these rich lands were drained and placed upon the market, we would not only stop the great tide of emigration from the United States to Canada, but in turn could secure many Canadians that are well-to-do, and who have become tired of that frigid climate and desire to migrate where they do not have to house their stock and themselves nine months in the year to keep from freezing, thereby consuming the most of their products made during the short-crop season."

In order to present the magnitude of the swamp areas of this country, it is simply necessary for us to state that it equals about one-sixth of the entire cultivated areas of the country.

These swamp lands are exceedingly rich in humus and valuable plant foods. When drained and prepared for cultivation, they will produce larger crops than any other existing soils.



DITCH BLASTED WITH DYNAMITE AT LOUISVILLE, KY.
NOTE WATER STANDING ON LAND



SAME DITCH AS ABOVE FILLED WITH WATER

Farmers have been using dynamite for draining swamps and wet fields for many years, and much valuable farm land has been reclaimed and made available for cropping by so doing. The cost of the work and of the explosives is very small compared with the value of the land reclaimed.

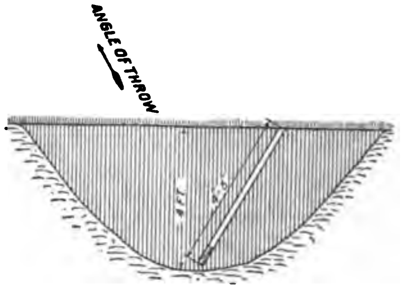
The draining is accomplished in one of two ways, depending upon conditions. Sometimes it is better to drain wet land by ditching, while at other times it is more practicable to permit the water to escape by a process of seepage through the soil.

It is not always possible to drain by ditching. Whether it can be done in that way depends upon whether the slope of the land permits. If the swampy or wet spot is low, surrounded on all sides by hills, ditching would not work. The draining can then best be done by subsoil blasting. This is done by exploding charges of dynamite sunk deep in the ground, which breaks up the hard soil and allows the water to find an outlet through the sand and gravel beneath. Whether this is practicable, of course, depends upon the thickness of the stratum of subsoil and also upon its depth beneath the surface soil.

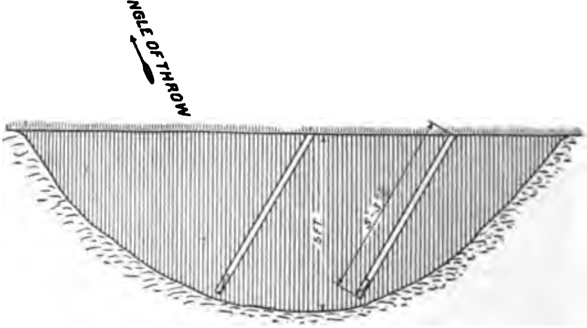
For ditching, blasting is superior to old time pick and shovel methods in every way. One of the most difficult problems the modern farmer has to face is the securing of farm labor. Therefore, any method of doing farm work which makes necessary the employment of fewer men is recognized as a good thing. To dig a big ditch quickly by manual labor requires the employment of a number of men for a considerable period of time. Where are the men to be had? Using dynamite for ditching solves the farmer's problem. One man equipped with a pointed steel bar, a sledge hammer and a supply of dynamite cartridges, fuse and blasting caps, or electric blasting machine, can excavate as much ditch in one day as several men could dig out with picks and shovels.

Blasting a ditch is a very simple matter. After driving the holes to the proper depth with the sledge and pointed bar, the blaster places the dynamite cartridges at the bottom of the holes, after attaching the detonators, fills or tamps the holes and then sets off the charges. In wet work, only one detonator is required, and that is a cap in the middle cartridge only. The wet ground carries the shock and detonates the other cartridges simultaneously. If water covers the cartridges, when placed in the holes, no tamping is necessary. In dry work, the detonation will not carry from one hole to another, hence each cartridge must be primed with an electric fuze, connected with a blasting machine and all fired electrically at the same time. The dynamite does all the work. If soil conditions are favorable, the result is a nice, clean ditch of the required depth and width, the earth being spread evenly over the ground along the banks, and turning in the water clears away what little of the dirt may have fallen back into the trench after the blast. The cost of ditching with dynamite averages from 9 to 11 cents per cubic yard, compared with an average cost of 25 cents per cubic yard when the work is done with pick and shovel.

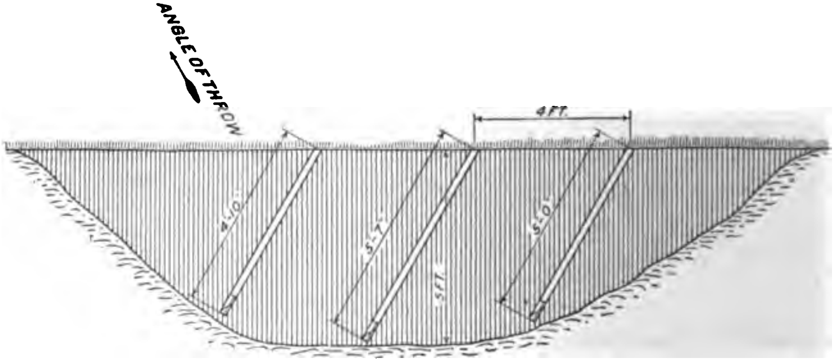
Dynamite is not recommended for excavating large ditches having a depth greater than 6 feet, but is strongly recommended in the construction of ditches of any depth under 6 feet.



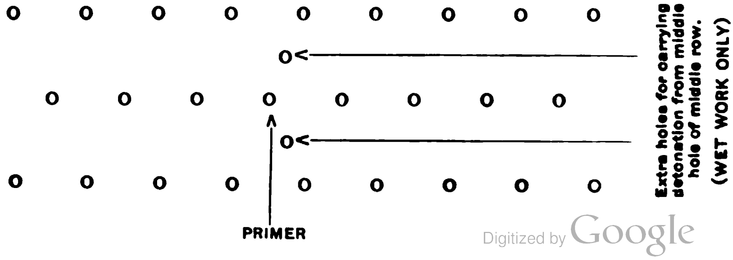
CROSS-SECTION SHOWING APPROXIMATE SIZE AND SHAPE OF DITCH EXCAVATED WITH SINGLE ROW OF CARTRIDGES



SHOWING LOCATION OF CARTRIDGES FOR WATER DITCHES USING TWO TO THREE ROWS



When there are two or three rows of holes they are sometimes alternated or staggered as follows:


PRIMER
Extra holes for carrying detonation from middle hole of middle row.
(WET WORK ONLY)

Capacity of Dynamited Ditches.

The size of a ditch excavated with dynamite depends on several elements:

1. The kind and condition of soil. 2. The amount and kind of dynamite. 3. The location of the charges.

Heavy, water-soaked soil is easiest to handle. The stiffer the soil, the wider the ditch for a given depth of charge. Light or loose soil blows out at a sharper angle. A single row of cartridges 18 to 24 inches apart, placed at bottom of center line of ditch at an angle of about 30° from vertical and about 4 feet below surface, will blow a ditch about 4½ feet deep by 8 feet wide in heavy, wet soil and about 4 feet deep by 6 feet wide in loose, light soil. For ditches 10 to 15 feet wide two rows of cartridges are required and for ditches 16 to 20 feet wide, three rows. In a three row charge, the middle row should be about 6 inches deeper than the sides to secure the best heaving efficiency and contour.

It is not feasible to blast ditches deeper than 6 feet in a single blast. From 100 to 500 feet in length may be blasted in one shot.

In comparing costs of ditching with dynamite with other methods it is necessary to consider the number of cubic yards of material excavated.

When a single row of cartridges is employed the excavation is usually "V" shaped. The area of the cross section can be obtained by multiplying half of the average width at the top by the depth. Thus, if the average width is 6 ft. and the average depth is 3 ft., the area of the cross section will be $\frac{3 \times 6}{2}$ or 9 sq. ft. Multiply this by the length of the ditch to get the number of cubic feet; divide the result by 27 to get the number of cubic yards. In case a wide ditch is excavated using two or three rows of cartridges, the middle section of the ditch will be practically the same depth for from five to ten feet and the shape of each side of the ditch beyond this level portion will be a triangle.

To get the cross section, first determine the width of the level portion in the middle, which may be 8 ft., for instance. Supposing the depth is 4 ft., then the area of that portion of the cross section will be 8 x 4 or 32 sq. ft., and the total area of the two triangles at the sides will be the average extreme depth multiplied by the average extreme width.

In the case cited the average extreme depth would be 4 ft. and the average extreme width would be about 4 ft. Therefore, the total area of the two triangles would be 4 x 4 or 16 sq. ft. Add this to the 32 sq. ft. already calculated for the middle section, and the total area of the cross section would be 48 sq. ft. From this the cubic yards may be easily calculated, as in the first example.

The entire cost, including labor and dynamite, of ditches from three to four feet deep, three feet wide at the bottom and five to seven feet wide at the top, is six ~~two~~ cents to eight ~~four~~ cents per lineal foot, or on an average of about twelve ~~six and two thirds~~ cents per cubic yard excavated. Ditches requiring two or three rows of holes and those from four to six feet deep will cost one-half more to twice as much per cubic yard as the narrower and shallower ones.

BEFORE THE BLAST, BURKETT FARM, NEWBURGH, N. Y.

THE BLAST

A FEW MINUTES AFTER THE BLAST

Successful Ditching on Farm of Editor of American Agriculturist

NEWBURGH, N. Y., JULY 18, 1911.

"The dynamite demonstration on my farm last week was an emphatic success. The ditching was a complete surprise to everybody. The dynamite certainly did the work and made as pretty a ditch as ever I saw. (See cuts on page 8.)

"The subsoiling work I am confident is full of promise. I shall follow all these matters very carefully from year to year and record just what results have been obtained.

"C. N. BURKETT."

A Professional Blaster's Report of Some Drainage Blasts

HUTCHINSON, KAN., JANUARY 16, 1912.

E. I. DU PONT DE NEMOURS POWDER CO.,
WILMINGTON, DEL.

Gentlemen:

Received your letter, have read it over carefully and would say regarding the Severance Farm. Where I dynamited has raised in value fifty dollars per acre and also the Wells Place three miles south of Hutchinson where I dynamited which was to drain ground, was just in small patches but he got enough wheat off the blasted ground to pay for shooting his whole eighty.

As for Mr. Spankenberger he had a big basin in the middle of his field. I went out there last February and shot fifty pounds of du Pont 40% Red Cross on this five acres and in one week from the day I shot this we had six inches of rainfall (in one week) and Mr. Spankenberger rode out to his field expecting to find a pond as usual, but to his surprise his ground was dry no water standing in this basin. This was a poor corn year in this country, but Mr. Spankenberger raised corn enough on this basin to more than pay for shooting this land.

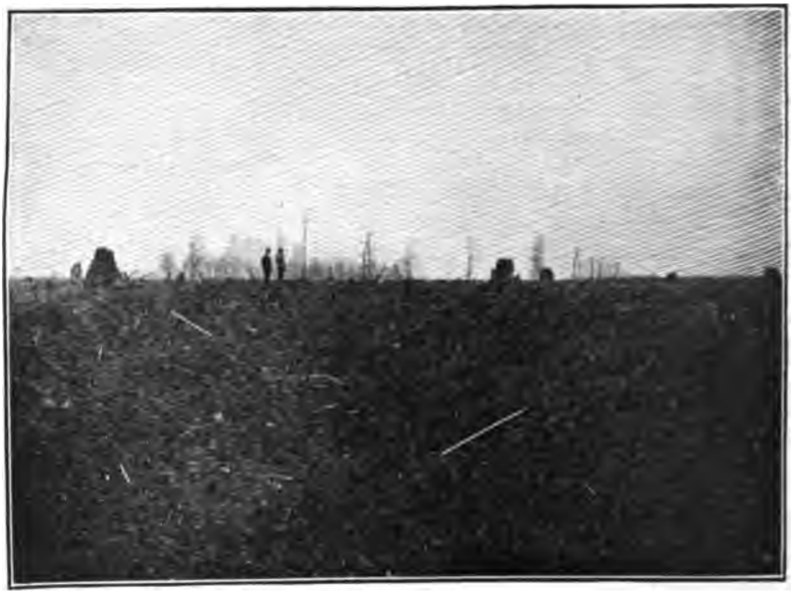
Mr. Jake Siegrist, four miles southwest of Hutchinson, had a piece of land similar to Mr. Spankenberger's and I shot fifty pounds of dynamite on it and he raised a corn crop on it this year. Also Mr. George Siegrist at Whiteside, Kan., had a piece of land on his place of five acres that was worthless. I shot thirty pounds of dynamite on this ground one year ago and today this ground is worth seventy dollars per acre.

I went up into Pawnee County two years ago and shot a piece of ground that was under water two feet deep at the time, consisting of thirty acres. I drained the water all off of that ground with twenty-five pounds of dynamite and Mr. Ford plowed this up and sowed it to alfalfa and he has got as nice a field of alfalfa now as there is in Pawnee County.

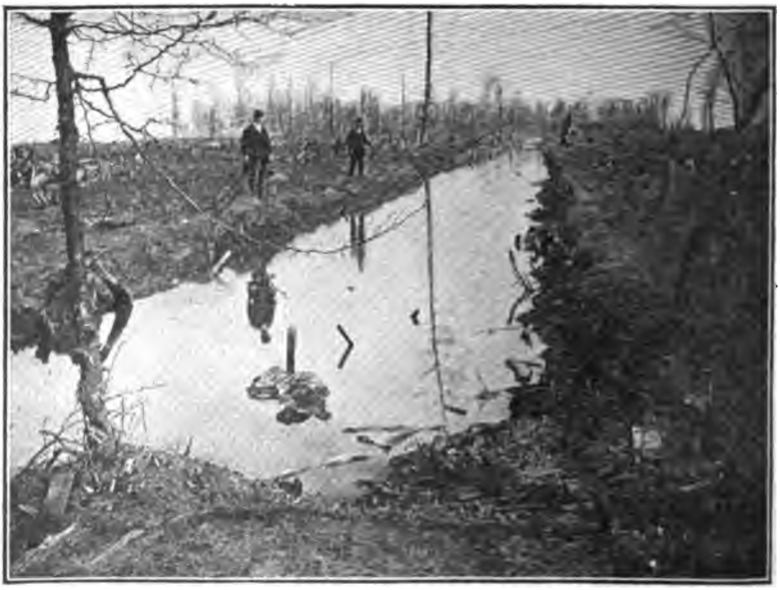
I also dynamited thirty tree holes for Mr. Friends in Rozel, Kans., and he did not lose a tree. I also dynamited thirty tree holes for Mr. Smith and every tree he planted lived but one. I dynamited thirty-one tree holes for Mr. Yaggar of Rozel, Kans., and his trees all lived, and trees don't grow in this country in an ordinary tree hole.

All of those places I have told you about I have kept personal track of and I know what they were and what they are now, besides dozens of others, and if you will print some of those pamphlets you sent me a copy of, I will try and take up the business again and see if I can do anything with it and also if you would advise people to correspond with me, I will do all I can to help them and you too.

Yours truly,
A. G. CRABB,
720 E. 7th Street,
Hutchinson, Kans.



AFTER A BIG DITCH BLAST AT DIEHLSTADT, MO.



SAME DITCH AS IN UPPER VIEW, FILLED

Land Value Increased $130.00 Per Acre

WHITESIDE, KANSAS, February 21, 1912.

In reference to the wet land shot for me by Mr. A. G. Crabb:

There never has been any water stand on this land since shooting. It cost me about fifteen dollars ($15.00), and I have had as good oats on it as on any of the field. This year it is in wheat, and the wheat looks better where the pond stood than on the rest of the field.

Before shooting this land was worthless, but I have since refused $130.00 per acre.

GEORGE W. SIEGRIST,
Hutchinson, Kansas.

Du Pont Dynamite Saves $435.00 for This Missouri Farmer, and Increased Value of His Farm by Increased Crops

On March 10th, 1911, a large ditch was shot at Diehlstadt, Mo., on the farm of Mr. Max L. Ostner. See opposite page, showing finished ditch and water flowing through it.

The length of the ditch made was 1,720 feet. Three rows of holes, 3 feet apart each way, were drilled, the rows being staggered. The center row of holes were 3 feet 8 inches deep and the two outside rows 3 feet deep. In each of the centre holes were loaded 3 cartridges, Hercules 50%, 1¼x8, and in each of the outside holes 2 cartridges. It was originally planned to fire the entire 1,720 feet of ditch with one set of primer holes, i. e., two holes in each row, these holes being loaded with an extra cartridge, containing the cap and fuse. When fired 500 feet of the ditch was cleaned out, and it developed that there was a dry sand ridge in the centre of the 1,720 feet which extended about 400 feet, this preventing the entire 1,720 feet from being excavated with the one priming. A second primer group was arranged and in this shot 800 feet of ditch was made. Several extra primings were necessary to get the dry sand ridge blown out cleanly. There was about 1 foot of water in all the holes blasted with the exception of those in the dry sand ridge. The soil in the remainder of the ditch was a sandy loam with some mixture of clay.

The ditch made was 16 feet at the top, 8 feet wide at the bottom and averaged 4 feet in depth. It was fairly well cleaned out all along.

They used 2,100 pounds of Hercules 50%, costing 14c. per pound, or a dynamite cost of $294.00 for the ditch. The labor cost was $35, making the total cost of the ditch $329.00. There was moved 3,058 cubic yards of material, costing 10.76c. per cubic yard for the entire work, against 25c. per cubic yard if the ditch had been dug by pick and shovel.

The temperature at the time of demonstration was 62 degrees F., in the sun, and 49 degrees in the shade. The temperature of the water in the holes was 35 degrees Fahrenheit.

Dynamite Cuts Cost in Two

ONAMIA, MINN., Aug. 9, 1911.

In regard to ditching with dynamite will say, it's grand in wet ground. The ditch dug on my place would cost me at least 80c. per rod, and with dynamite it was less than half; and then such quick work. One minute after loading was done the water came running in like the ditch had been there all the time. I think it was fine.

Yours very truly,

PETER PETERSON.

DYNAMITING DIGS DITCHES THROUGH LAND THAT CANNOT BE ECONOMICALLY HANDLED OTHERWISE

A DITCH BLASTED AROUND A CORNER IN ONE BLAST

8000 Acres Reclaimed by Ditching

HERNANDO, MISS., Jan. 15, 1912.

Your letter received this A. M. in regard to the use of explosives. I have had a very remarkable success in this line, especially in blasting stumps, ditches and hardpan.

There was a large drainage district in this county, called Hurricane Swamp Land District, comprising about eight thousand (8000) acres of land not susceptible to cultivation. Bonds were issued to the amount of $10,000 for a ditch 8 feet wide and from 2½ to 10 feet deep. My father was interested in several thousand acres of land in this district, so he bought the bonds and carried out the contract of excavating the canal.

I was put in charge of the above work and completed the canal, using over two thousand (2000) dollars worth of Red Cross Dynamite bought from Levi Joy & Company, of Memphis, Tenn. I started this work, removing the stumps with a stump puller, but found I had struck a hard proposition. My first order for one thousand (1000) lbs. of 40 per cent. dynamite made the stumps come so easy that I thought blasting the ditch was possible, so I began and in a few days could remove more dirt for $1.50 invested in dynamite than $3.00 of shovel work. I made average of handling dirt at 11½c. per cubic yard where it would have cost me 20c. to shovel same. Where the cut was more than 6 ft. negroes would not attempt to use the shovel but wanted barrows. So here is where Mr. Negro lost out, as the dynamite blew it out most successfully.

The above canal was in made land from 4 to 10 feet deep and required considerable boring to get under some of the largest stumps, but after the explosion I had no bother with pulling the remains off right of way. In using the stump puller it was more trouble to remove the stumps after being pulled as the dirt remaining on some of the stumps would weigh tons and had to be loosened and knocked off with the use of two (2) sticks of dynamite. When using dynamite a man could roll it off with little trouble right away, and without the dynamite he could have hardly pulled it off with eight yoke of cattle.

The above canal was cut 8 feet wide to bring it from 20 to 40 feet wide and 8 to 20 feet deep and this land that was worthless is now the finest land in the county. I have used the 40 per cent. dynamite in all of my work and we attribute the fast coming and washing due to the use of your explosives. I hope to dynamite about 15 acres on my own farm between now and the 15th of March. The above work will be subsoiling as we have a very heavy clay subsoil in this district. I thoroughly understand setting trees with dynamite and all its branches. Yours very truly,

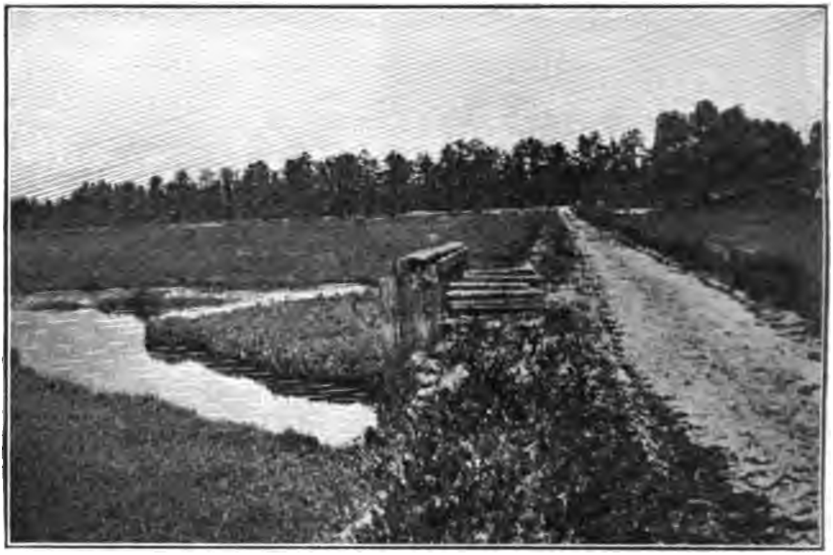
N. C. BANKS,
Box 14, Hernando, Miss.

A Good Investment

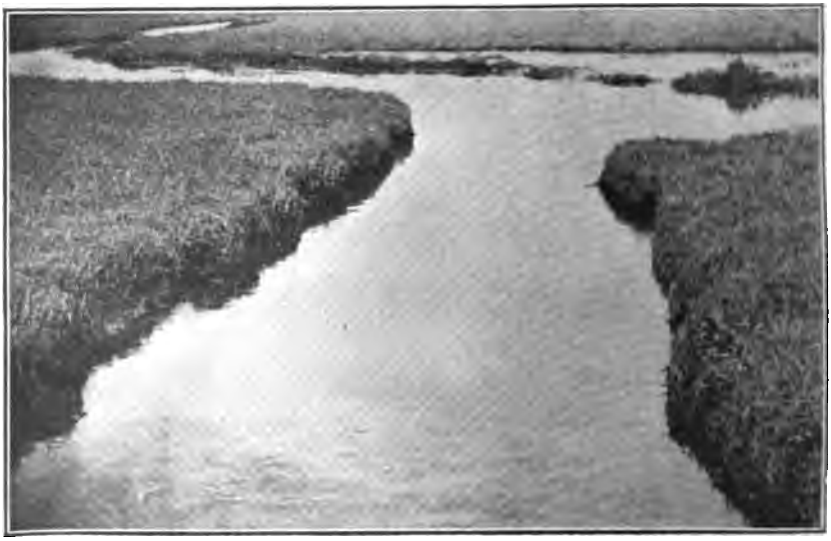
As an instance of the practicability of subsoil drainage we will quote the following from the report of one of our demonstrators:

> "Mr. J. B. Shaffer owned a 40-acre tract of land in Sedwick County, Kansas, that for twelve years had been idle and useless on account of water which covered it to a depth of three feet. One of our men, using 100 pounds of dynamite, blasted holes 40 feet apart across this tract, placing two sticks of dynamite in each hole and firing them. That same year the owner harvested 40 bushels of oats per acre from that 40 acres of ground. He then put the same land into alfalfa, since which time he has been cutting four crops per year."

Compare the value of four crops of alfalfa per year for eight years with the cost of the explosives used to reclaim this land.



DITCH BLASTED WITH DYNAMITE
RIDER CRANBERRY BOGS, HAMMONTON, N. J.



ANOTHER DYNAMITED DITCH ON RIDER BOGS

Ditching Cranberry Bogs.

This class of ditching differs from the ordinary because what is required is not merely a means of removing surplus water from land, but also a means of flooding the same land several times a year.

The sort of land best adapted for cranberry culture is ideal for ditching with dynamite because wet and heavy.

The method used is by propagated blast from a central detonator, no battery or electric fuzes being required.

The letter printed below is from one of the country's leading cranberry growers and a pioneer in the use of dynamite for ditching, he having successfully used it for twenty years. At the 1911 annual meeting of the American Cranberry Growers Association, Mr. Rider stated he had never experienced any casualties in using dynamite and considered it safer to handle than gasoline.

Note his statement regarding effect of blasting on fungus. This bears out similar experiences of orchardists.

Dynamite Successfully Used for Twenty Years in Cranberry Growing

Mr. A. J. Rider, Secretary of the American Cranberry Growers' Association, of Hammonton, N. J., writes.

I have used dynamite in the development of my cranberry enterprises with success and economy for the past twenty years. In removing obstructions from water courses, opening ditches and preparing the way for dams and flood-gates, it is especially useful. I keep a supply on hand at all times, and my foremen are all instructed in its use. The saving in time and labor thus effected is very great.

Dynamite will make a straight ditch and under conditions with which nothing but a dredging machine could cope. In excavating for flood gates the mud walls are temporarily packed so solidly that water hardly seeps through. A crow bar and a stick of dynamite will stop a leak in a dam that would otherwise require hours, and possibly days of labor. All cranberry plants are susceptible to fungus diseases, and much experimenting has been done by growers and government experts to control this enemy. Without being able to give scientific reasons I owe it to dynamite that there has never been fungus growth at Hampton, one of my largest plantations, where I have used it freely.

If the advantages to be obtained through the use of dynamite were brought to the attention of all large cranberry growers I believe you would be doing them a great service.

Very truly yours, A. J. RIDER.

PLACING CHARGE FOR DRAINING POND AT NEWARK, DEL.

A FEW MINUTES AFTER THE BLAST OF POND

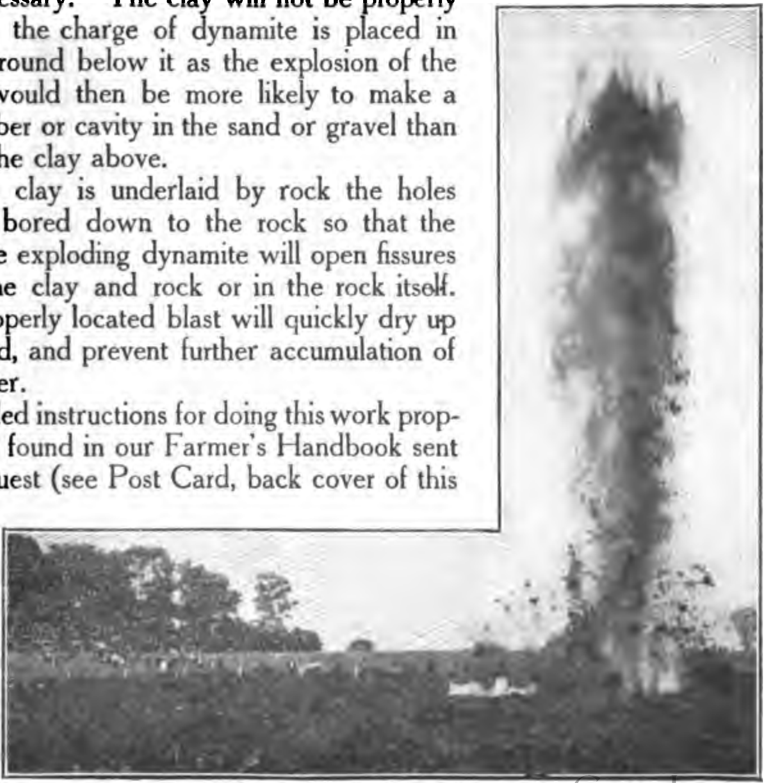
Draining Frog Ponds or Wet Spots

Swamps and ponds, except where they are close to rivers, lakes or the ocean, are caused by spring or surface water collecting on low ground without a lower outlet and which is underlaid by clay or other subsoil that the water cannot sink through. When it is not practicable to drain these swamps by ditching they can often be permanently dried up by shattering the impervious subsoil in the lowest places with dynamite. It is generally best to blast in three or four places and sometimes a row of holes spaced twenty to thirty feet apart, across the pond or swamp where the water is deepest, will give the best results. However, the number of holes necessary depends on the area to be drained and the thickness of the impervious soil or clay underneath. This is sometimes many feet in depth, but is usually from two or three feet to thirty or forty feet. To satisfactorily drain away the water above it is necessary to break this subsoil entirely through and to do this the holes for the dynamite should be drilled almost through it—say within two feet of the bottom —if gravel, sand or other open earth lies below the clay. In order to do this, a test hole to determine the exact thickness of the clay is of course necessary. The clay will not be properly shattered if the charge of dynamite is placed in the open ground below it as the explosion of the dynamite would then be more likely to make a large chamber or cavity in the sand or gravel than to shatter the clay above.

If the clay is underlaid by rock the holes should be bored down to the rock so that the force of the exploding dynamite will open fissures between the clay and rock or in the rock itself.

A properly located blast will quickly dry up such a pond, and prevent further accumulation of excess water.

Detailed instructions for doing this work properly will be found in our Farmer's Handbook sent free on request (see Post Card, back cover of this booklet).



BLASTING THE POND SHOWN ON OPPOSITE PAGE

DEEPENING CHANNEL OF STREAM WITH DYNAMITE

Straightens Creek with Dynamite

YALMAR, MICH., Sept. 21, 1911.

The ditching proposition hit me the most and would never believe until I saw your men do it here, as the creek was making all kinds of turns and swings and cutting my farm up in an awful shape, and I could have had it done long before this if I had only known how, and with a great deal less labor and at half cost than to do it with a team and scraper. Even then it would have been very hard to get it done on account of all the roots and big stones there are in places which were easily shot out with dynamite.

The ditch they shot here to my measure was 80 feet long and 7 feet wide and 3½ at bottom, 3½ feet to 4 deep with the cost of $2.25, which would cost me close to $1.25 per rod if I was to have it done with team and scraper or with a shovel.

CHAS. WILSON.

Blows Out Mudholes

Dynamite Used to Improve Roads in Kansas

By Breaking Up the Hardpan Underneath, the Water Soaks Into the Subsoil, Leaving the Highway Surface Dry and Passable—Township Trustee Puts Unique Plan Into Use.

ST. JOHN, KAN., Feb. 29.

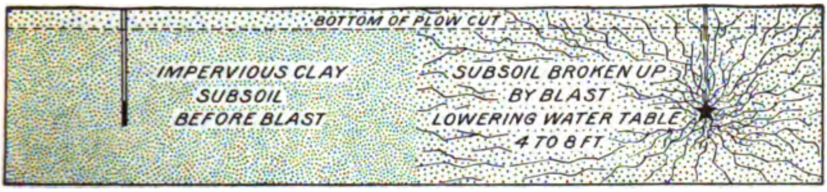
Samuel Newell, Trustee of Fairview Township, has solved the problem of mudholes in county roads. He blows them out with dynamite, quickly and cheaply. In one of the roads in his township was a mudhole a quarter of a mile long, practically impassable even for light buggies. Motor cars couldn't get through it at all.

Mr. Newell read about deep plowing with dynamite and how the giant powder had been used in drainage work, so he decided to try it. He drilled holes every hundred feet through that stretch of mud and put a blast of one stick of dynamite in each hole and blew up the whole roadway.

These explosives broke up the hardpan under the road and permitted the water to drain into the subsoil. Newell then put his road graders at work and graded the road so it could be used. All winter long that road has been about the best in Stafford County. Within a few hours after the heaviest rain the water disappears and the melting snow soaks into the ground so that the road is dry as soon as the snow is gone.

The stretch of road is now passable by any sort of vehicle and carrying the heaviest loads. Farmers who formerly had to drive two miles out of their way to haul wheat to market can haul the usual load over this road at any time. The road was through a low, swampy place and now it remains dry and hard while the water covers the surrounding land. Other bad mudholes in Stafford County are to be blown up this spring, as the road workers there consider the plan a success in every way.

Underdrainage of Hardpan Land


BOTTOM OF PLOW CUT
IMPERVIOUS CLAY SUBSOIL BEFORE BLAST
SUBSOIL BROKEN UP BY BLAST LOWERING WATER TABLE 4 TO 8 FT

Land that has a waterproof subsoil is practically worthless, as in wet weather it holds the surface water in such quantities on level ground that the roots of trees and plants are "drowned" or rotted away; and in dry weather such land does not retain moisture and the vegetation dies quickly. Such land can be rendered fertile at once by blasting with "Red Cross" Dynamite. The hardpan is completely broken up, water-storing capacity increased, and the dry, dead topsoil converted into a rich loam for less than the amount of the taxes for a year or two.

The following extract from the Topeka, Kansas, "Mail and Breeze" proves the wonderful results of this use of dynamite:

> "A few years ago M. T. Williams bought a quarter section of land near Medicine Lodge in Barber County, and, conceiving the same idea that Ex-Governor Crawford and others have, used dynamite in dealing with a hard subsoil. The land was overgrown with sunflowers and cocklebu rs and would have been considered dear at $10 per acre. It was underlaid with a hard subsoil that was almost impervious to water. Mr. Williams' idea was to loosen this subsoil with dynamite. He bored holes in the earth some 3 feet deep and about 40 feet apart, and in each hole placed a part of a stick of dynamite. The explosion of the dynamite loosened the hard subsoil, and made a reservoir for the rains, which had formerly run off the land nearly as fast as they fell. On this quarter there is now 100 acres of, perhaps, as fine alfalfa as can be found in the state. Mr. Williams has refused $15,000 for the quarter and gathers a net income from his alfalfa of from $30 to $35 per acre every year.
>
> "Last season Mr. Williams proposed to the ladies of the Baptist church that he would give them a load of hay, provided they would come out to the place, shock the hay, load it on wagons and haul it to town. They took him at his word and shocked and hauled to town two tons which sold for $16. When the second crop was ready the ladies came again, and 'touched' Mr. Williams for a little more than two tons which sold as well as the first load." (See cut at bottom of this page).

MAKING HAY FOR THE CHURCH ON A DYNAMITED FIELD WHERE FORMERLY LITTLE OR NOTHING GREW

Ditching With Dynamite Endorsed By High Authority

UPPER PENINSULA STATION
Leo M. Geismar, Supt.
Michigan Experiment Station

Chatham, Mich., March 11, 1912.

E. I. du Pont de Nemours Powder Company,
Wilmington, Del.

Gentlemen:

I have used many tons of dynamite within the past twenty years, both in removing stumps and for breaking up large boulders, and having never seen dynamite used for digging ditches, I became interested in a demonstration which your Company made in this neighborhood last summer. The test was made on a side hill underlaid with a ledge of magnesian limestone about five feet below the surface. Springs about half-way up the side hill kept the lower half of the hill and about six acres of the level ground below in an extremely wet condition. The soil is a sandy loam which contains a few small boulders and many large, flat stones thrown into various positions and weighing from 20 to sometimes over 150 pounds each. Hand digging in such ground is necessarily slow, for ditches have to be dug wide at the bottom to keep from caving in, and many large stones must be either broken up or removed with crowbars. There are several of these side hills in this neighborhood, and two men rarely average more than a rod and a half a day in digging ditches on such ground.

To cut the water off, a ditch four rods long was blasted out with dynamite, the amount used being evidently more than would have been necessary, for it not only opened a ditch of ample width, but shattered nearly a foot of the solid ledge of rock in the bottom. The cost was as follows:

Dynamite and caps with fuse	$3.00
1 man, 1 hour with dynamite	.25
1 man, 2 hours cleaning out bottom of ditch	.35
Total	$3.60 or 90c. a rod

With two men digging one and a half rods a day and getting each $1.75 a day, the cost per rod would have been $2.33 or over two and a half times more than the cost of digging with dynamite. This demonstration convinces me that on ordinary ground, especially heavy clay, the cost of digging with dynamite must be less than one-half the cost of hand digging. Furthermore, the work of digging with dynamite is done so rapidly that the advantage thereof cannot well be overlooked.

Very respectfully yours,
LEO M. GEISMAR, Supt.

A Successful Drainage Test

DELAWARE COLLEGE
NEWARK, DELAWARE
Geo. A. Harter, M. A., Ph. D., President

March 20, 1912.

E. I. du Pont de Nemours Powder Company,
Wilmington, Del.

I drove down to the farm yesterday to see the spots which Mr. Hill, of our college, has blown out with dynamite to test its efficacy in draining such areas. I found a number of flat basins scattered around over several acres of ground. Mr. Hill informed me that the stratum of clay extends downwards to three or four feet; then occurs a stratum of sand. Mr. Hill, it seems, bored holes to the depth of three feet or three and a half feet and exploded charges of dynamite. He reports that before his experiments rainfall always gathered in these basins and would lie for weeks before it would all be evaporated or absorbed in the almost impervious clay. After his experiments he reports that water disappears from these basins very soon after a fall of rain, no matter how heavy it may be. When I visited the ground yesterday I found very little water in any of these depressions. You remember on last Friday we had a very heavy precipitation here.

GEO. A. HARTER, President.

Former Pond Yields $75 Per Acre Crop

UNITED STATES DEPARTMENT OF AGRICULTURE.
BUREAU OF PLANT INDUSTRY,
Washington, D. C.

OFFICE OF FARMERS' CO-OPERATIVE DEMONSTRATION WORK.

MORRILLTON, ARK., Jan. 18, 1912.

E. I. DU PONT DE NEMOURS POWDER COMPANY,
WILMINGTON, DEL.

Gentlemen:

As per your request, I here give you my experience with dynamite as a water sinker in my field in Georgia.

I had a lime sink in my field and the water would collect in that basin and would cover about one acre and a half of ground, so some years when we had excessive rainfall, I could not plant it to anything.

My brother came to see me on a visit and he said: "Why don't you put down a hole 25 or 35 feet and shoot it with dynamite and sink the water?" So I put down a hole 23 ft. and shot it, and it sunk the water.

I weighed the corn that I gathered from the 1½ acres the first year and I got a few pounds more than 100 bushels of just as good corn as I have made in my life. This made more than $75.00, whereas I had been getting nothing from this land, besides it was very disagreeable to have to work around this wet spot each year.

That was the only year I gathered the corn separately, although it seemed to be better every year I cultivated it until I sold the farm, and I do know that the land worked better every year. This experience of mine, and the results which I secured, is what makes me recommend subsoiling with dynamite so strongly.

Yours very truly,
JOHN W. PARLIN,
Special Agent.

Underdrainage Increases Land Value $100.00 Per Acre

FAYETTEVILLE, N. Y., Nov. 4, 1911.

You may be interested in learning that I had about six acres of worthless land, which was mostly bog and trash, that has been successfully drained with Red Cross Dynamite.

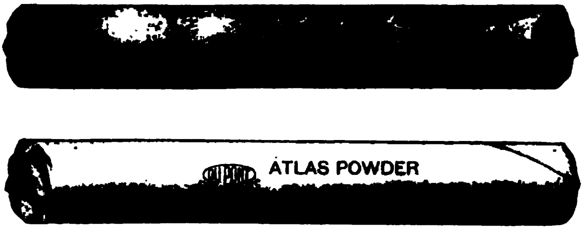
This land was always covered with water, due undoubtedly to a stratum of shale limestone underneath, but by drilling down through this limestone from 8 to 12 feet deep at the lowest spots in the swamp, I not only succeeded in draining the entire six acres, but since then it has been planted to corn and potatoes and now to alfalfa, which is yielding as high as five tons per acre.

The cost of this draining work was about $100.00 including cleaning up the brush, etc., which I consider most economical. In fact, I could not have drained this bog economically excepting by the use of dynamite.

I might also add that the value of this land has been increased from practically nothing to $100.00 per acre.

Yours very truly,
F. E. DAWLEY.

THE BEST DYNAMITE FOR DITCHING OR DRAINAGE IN DRY GROUND, WITH FUZE IN EVERY CARTRIDGE, FIRED ELECTRICALLY



THE BEST DYNAMITES FOR DITCHING OR DRAINAGE IN WET GROUND, WITH FUSE AND CAP IN MIDDLE HOLE ONLY

How We Can Help You.

For more than a hundred years we have been making and selling explosives. We maintain a highly skilled corps of chemists, explosives specialists, and field representatives, whose sole duties are to study conditions and devise means for handling them.

If there is any soil condition on your farm that we have not mentioned, and which you think might be remedied or improved by dynamite, please write us all about it. There will be no charge for the information we will send you; in fact, we will be much obliged to you for giving us the opportunity to study any peculiar condition.

Bear in mind that the age, reputation and high standing of this Company are ample assurance that any statements made by us are conservative, and based on long and varied experience.

Instruction Book Sent FREE

If the foregoing pages have convinced you that possibly explosives can be used to advantage on your farm, the next questions that will arise in your mind are: How are they used? What do they cost? What quantities are needed? What other supplies or apparatus are needed, etc.? All these things are fully and clearly explained in our larger booklet, "The Farmer's Handbook of Explosives," which may be obtained, free of charge, by cutting out and mailing the card No. 1 printed on the inside back cover of this pamphlet.

We believe that when you have read the book, you will understand how simple, safe and economical the use of Du Pont Dynamite is, and that you will find many ways to save and make money with its aid.

E. I. DU PONT DE NEMOURS POWDER CO.
WILMINGTON, DELAWARE

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AGRICULTURE

THE DU PONT FARMER

DU PONT

USES OF

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Safety First

DU PONT
AND
REPAUNO

Stumping Powder

Are the safest agricultural explosives manufactured; because least sensitive to ordinary shocks.

Nevertheless, with a powerful blasting cap (No. 6) to detonate them their execution is perfect. This combination makes the ideal agricultural explosive.

Do not permit an unscrupulous dealer to substitute something "*just as good*" or "*all the same thing.*" Make "*SAFETY FIRST*" your own rule in handling explosives. That means demand Du Pont and Repauno brands and accept nothing else. If the wrapper on the powder doesn't bear these cartridge markings, it is *NOT* our product.

The best is the cheapest as well as the safest. That means you want Du Pont or Repauno Stumping Powder.

Special Explosives for Farm Work

Gilbert Ellis Bailey, A.M., E.M., Ph.D., Professor of Geology at the University of Southern California, in a bulletin issued in January, 1914, says:

"The writer believes that deep plowing and cultivating of the soils by means of explosives is almost as great a step forward as irrigation. He believes that the time has come when explosives should be made especially for agricultural uses—explosives that will be safe to use, safe to handle, and safe to store on the premises.

"The agriculturist should use only explosives especially prepared for his work. He should use an explosive that stands all ordinary shocks of handling and transportation, that does not easily freeze. He does not need and should not use the expensive high grade nitroglycerin explosives. The various grades of low explosives that cost less will do all his work from stumps and boulders to deep plowing better than high explosives."

The E. I. du Pont de Nemours Powder Company, the pioneer powder maker of America, and always the leader in everything pertaining to explosives, foresaw the universal demand for a special agricultural explosive and met this demand by placing on the market its Du Pont and Repauno Stumping Powder, designed for use in subsoiling, tree planting and stump blasting. For boulder blasting, stump blasting in sandy soils and ditching, requiring a quicker and stronger explosive than the stumping powders, we recommend Du Pont Straight N. G. 60 per cent. dynamite.

Our agricultural brands meet all of the requirements specified by Prof. Bailey in his agricultural bulletin.

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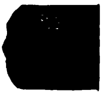

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CLEARING STUMP LAND

Every farmer knows that time is wasted when he has to plow around stumps, dead trees, and boulders. He knows also that they prevent the proper cultivation and rotation of crops, and that seeding and harvesting machinery cannot be used around stumps. These things are bad enough, but what is worse is the fact that the stumps are thieves, robbing the farmer of ground that is needed, and that should be raising valuable crops. They also harbor mice and insect pests. It is difficult to calculate in dollars and cents the gain in land where the stumps have been removed. That it is large is evident if one stops to think that an average stump wastes ground that would support a profitable fruit tree, or half a dozen hills of corn.

Farmers noticed long ago that crops sown where stumps had been blasted were heavy and healthy, especially during dry spells when those on adjoining ground were dried up and sickly. This is, of course, due to the stirring up of the soil deeply, increasing the water storing capacity.

It is bad economy to burn stumps, as it wastes time watching the fires, and it is impossible to burn below the surface to plowing depth. Burning also destroys humus and the fertility of the soil undoing the work of Nature in mellowing the earth. It is almost impossible to burn a green stump, or to remove the roots of any stump by burning so that they will not interfere with the cultivation of the ground. Digging out stumps is not only hard, slow and expensive work, but it leaves a great hole that has to be filled up and roots that are ever a nuisance.

Pulling stumps is hard work, leaves holes to be filled, and a hard-packed soil to be plowed. If the stumps are pulled by machinery it requires too much time and power and too heavy an investment that rapidly depreciates in value.

Why chop, dig, burn, or pull stumps when there is a quicker, better and cheaper way; one that requires little capital, few and simple tools, and no expert experience? Stumps can be removed by explosives at a fraction of the cost of pulling, and the stump is at the same time split up in fragments, the roots are broken up and the ground below and around is loosened, mellowed and invigorated. There is not only a saving of time and money, but an actual benefit to the soil, for it is better than if the land had been fertilized in the usual way.

After the stumps are all blasted out, you will have a new, rich field, easy to cultivate, and which will yield bumper crops.

Google

WHICH IS YOUR PICTURE?

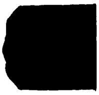
DYNAMITE A NECESSITY FOR LAND CLEARING

We have obtained excellent results with your explosives in the clearing of our cut-over lands. We believe that dynamite is a necessity in the successful clearing of stump lands, and the day is not very far distant when the farmer will depend as much upon dynamite for clearing and cultivating his land as the contractor does for removing rock in railroad construction.

THE MICHIGAN LAND & LUMBER CO.

Clarence F. Carey, Sec.-Treas.

Careywood, Idah



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WHICH IS YOUR PICTURE?

The pictures on the preceding page tell a vivid story—one of good farm management, the other of bad. On represents Mr. Marriott, a western farmer, the author of th following letter to one of his friends:

"Well, yours truly can now sit on a riding cultivato and cultivate ten acres a day, whilst just over the fence i a poor old-timer dodging stumps and cursing both lou and long while plowing (or trying to) about four acres a day and where there is a stump, he loses from eight to fourteen hills of corn."

He can afford to sing and be happy.

The other picture represents his neighbor, the old-timer. No wonder he swears. He has troubles enough to make anybody "cuss."

Which picture looks the nearest like you and your farm, Mr. Farmer?

An enterprising farmer has given the question of stump clearing very careful attention. He has figured it out that an average square foot of his land would produce at least one cent's worth of crop; that the average stump takes up 25 square feet. Thus every stump in a cultivated field costs the farmer from 25c to 50c a year. Not only that, but the stumps are breeding places for vermin and every stump will have a lot of undesirable weeds growing around it, the seeds from which spread over adjoining land and mix weeds with the crops.

If this farmer's arguments are sound, and we believe they are, the farmer who permits a stump to remain in a cultivated field loses as much or nearly as much every year as the explosives would cost with which to remove it. If he allows the stump to remain five years, he loses five times as much as it would cost to remove it. Can any farmer who conducts his farming operations in this way claim to be a good business man? Can he expect to be successful as a farmer? Can he expect ever to become wealthy at the business?

Again, suppose a farmer should want to sell his farm. The appearance and condition of it would have much to do with what it would bring. If stumps are seen in the fields used for cropping, the prospective purchaser at once forms a bad impression of the place and if he offers to buy at all, fixes his bid according to his view. Many farms have been sold at prices much higher than surrounding places would have brought, not because they are better farms or would produce larger crops, but simply because they presented a neater, cleaner appearance.

Du Pont Stumping Powder Useful in Farm Work

Blasted 35 stumps with Du Pont Stumping Powder at one-half the cost of any other method. Have more stumps to remove and will use Du Pont Stumping Powder. Stump puller isn't in it.

Planted some peach trees with Du Pont Stumping Powder and think it is great.

DR. C. G. BROWN,
Spokane, Wash.

Couldn't Get Along Without Du Pont Stumping Powder

During the past two years, I have blasted about 50 fir, edar and Madrona stumps of all sizes. I would not think f undertaking it by any other method than with Du Pont tumping Powder. I shall use the Stumping Powder whenver I do this work and I have done all of it, so far, by nyself.

E. M. RICE,
Longbranch, Wash.

Land Quadrupled in Value by Clearing

Blasted stumps ranging in size from 6 inches to 5 feet with Du Pont Stumping Powder. Value of land increased from $50 and $75 per acre to $200 or more per acre. Du Pont Stumping Powder is the best method by far for removing stumps.

J. FINLEY HEACOCK,
Stanwood, Wash.

Five Thousand Acres Cleared With Du Pont

We have used Du Pont Stumping Powder successfully in our land clearing department during the past two years. We have cleared during that period of time approximately 5,000 acres of land. The land was originally covered with pine, fir and tamarack, ranging in size from three feet in diameter down.

The powder serves the double purpose of splitting the stump and jarring the soil loose from the roots. We previously tried donkey engines without the use of dynamite; experience showed that a very large amount of soil adhered to the roots, leaving the ground uneven and requiring further work in cleaning the roots, before the stump could be burned.

We have used both the Du Pont Stumping Powder and Red Cross Extra 40 per cent. dynamite. Both have their advantages and which is the most economical depends upon local conditions.

ARCADIA ORCHARDS COMPANY,
Deer Park, Wash.

Stumping Powder Cheaper Than a Donkey Engine

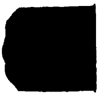
There was a piece of land on my property which I wished to clear. During the first week in March I moved about forty fir and cedar stumps with Repauno Stumping Powder.

This work cost me about $1 per stump, a total of $40. The stumps ranged from one and a half to three feet in diameter, and would have cost $2.50 per stump or a total of $100, taken out by any other method.

I have quite a number of stumps to move this fall, averaging about three feet in diameter and will certainly use Repauno.

There was a donkey engine working on my neighbor's place, but I beat it with my powder.

BURT P. WEISE,
Carrolton, Wash



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Uses Explosives for a Variety of Purposes

Having read of the great number of uses to which you were putting your explosives I tried out several classes of the work to my entire satisfaction. I had three acres of greasewood which I wished to clear and with about 125 pounds of your 20 per cent. powder cleared this land of the heavy growth at a much cheaper figure than it could possibly have been done by any other means. Furthermore the crop of clover to which this ground was sown is of A-1 variety and size and the usual lack of growth on land where greasewood has grown was not evident in any part of the field.

This spring I set out about 900 apple and pear trees in holes which I shot with but one-eighth pound of 30 per cent. and at this time the result has been but a 4½ per cent. mortality as compared with a 10 to 20 per cent. loss in some other tracts where I used spaded holes. The growth in this first year is twice as great as in the orchards planted in spaded holes.

Then I subsoiled three acres of apple trees planted in spaded holes two years ago which were failing to make proper headway and the result has been that all of these trees made from four to six feet of growth this season. The trees are 22 feet apart and I broke the hardpan at an average depth of four feet in the tree rows. I used ⅜ pound of 20 per cent. powder for these shots.

I also removed quite a number of sunken boulders on my place using 60 per cent. Red Cross Extra and this work was also entirely satisfactory.

You can judge from the above that my experiments have proved that your contentions were apparently based on logical reasoning and your own experiments and I can unhesitatingly recommend the use of your products for the uses for which you claim advantages in orchard and farm work. I will do a large amount of shooting this season.

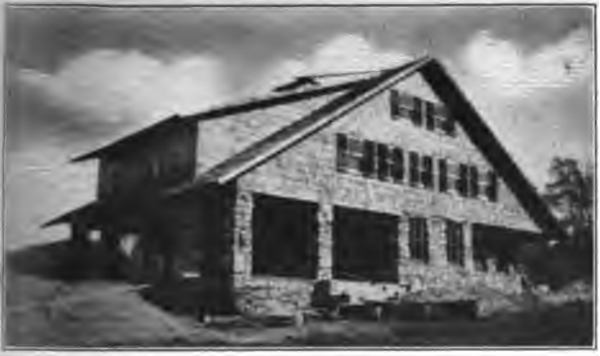
JAMES W. MATSON,
No. Yakima, Wash.

RID YOUR LAND OF BOULDERS AND LEDGES

In many sections of the United States ledges of rock, loose stones and boulders of various kinds litter the landscape. When they appear in fields which are farmed, they are a serious handicap to the farmer because they take up valuable space which, if planted, would add considerably to crop yields; they break agricultural implements which are used in cultivating the fields, and the soil immediately surrounding them becomes a breeding place for weeds, the seeds from which are blown over the fields and mix with the crops.

We don't blame any farmer for disliking the task of breaking up these stones and boulders with a drill and sledge hammer. It is slow and hard work. Du Pont Straight N. G. 60 per cent. Dynamite, however, smashes the toughest boulder as easily as a folded newspaper smashes a fly on a window-pane. A little of the explosive placed in a block-hole in the boulder, or in a snakehole under it, disposes of it in a few minutes, and the hard work is all done by the Dynamite.

Clearing farm lands of boulders must not be counted as all expense or outlay. In the course of a few years the crops raised on the ground in which the stones formerly laid will usually pay the cost of the clearing. Not only that, but the broken stones themselves are often valuable. They can be sold to builders or used by the land owner himself in constructing stone buildings or foundations for buildings, or repairing roads, building stone fences, etc.



THE HOUSE THAT STACK BUILT

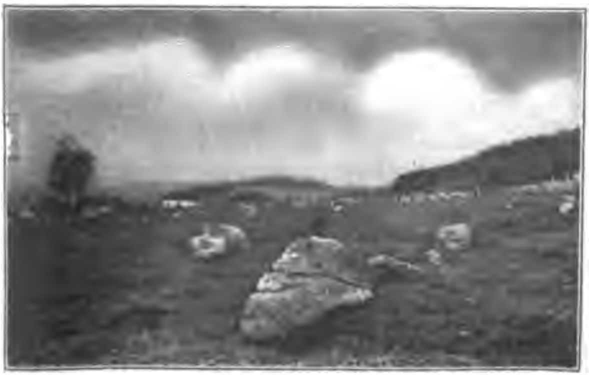
Mr. G. M. Stack, a landscape gardener, a few months ago was the unhappy possessor of a boulder-strewn field which was unproductive, unsightly and useless generally.

Now Mr. Stack is the happy owner of an unusually productive potato patch and a fine stone house.

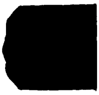
A few dollars' worth of Du Pont Straight N. G. 60 per cent. Dynamite accomplished the transformation. This valuable constructive agent quickly reduced the boulders to a size which rendered them easily conveyed to the site of the building. Stone masons used the pieces in constructing the house.

This wasn't exactly a case of killing two birds with one stone. On the contrary, it was a case of reducing a large number of big stones into a much larger number of small ones and converting the small ones into a valuable dwelling house. Great is Du Pont Dynamite when used as an agent of construction rather than destruction.

There are hundreds of acres of rock-strewn fields in this country. They include some of the richest soil to be found anywhere in the United States. If their owners would invest in a little Du Pont Dynamite to be used in clearing them, they might have valuable farm lands and stone buildings in place of useless pieces of property.



THE FIELD BEFORE CLEARING



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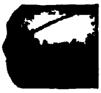

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DITCHING

Nearly every farm needs some ditches, varying from shallow surface drains for wet weather relief to wide and deep channels that will carry constantly a considerable volume of water.

All such ditching can be done with Du Pont Straight Dynamite, 60 per cent. strength, much quicker and with less labor than by any other method, and often cheaper. In many cases when the cost is not lowest by this method it is still best because of shortage of labor or lack of time to apply other methods.

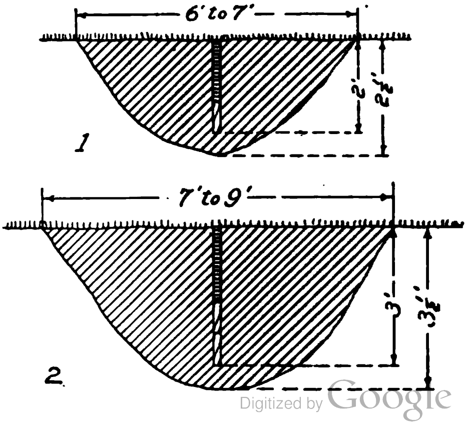
Ditches are blasted by either of two methods: (1) by propagation of explosive shock from one cartridge to another, and (2) by electrically detonated charges.

The first method is feasible only in wet, mucky or saturated clay soils, wherein the whole mass of soil is unified by the presence of water and contains practically no air spaces. The temperature of the soil and water must also be warmer than 50 degrees Fahrenheit. Du Pont Straight Dynamite of 60 per cent. strength must be used.

The second method is feasible either in wet or dry soils and in temperatures as low as the freezing point of water.

Ditches approximately 3 feet deep and 6 to 7 feet wide through average soils can be blasted at a cost of from 4 to 6 cents per running foot.

Of course, if there are any stumps or other obstructions in the line of the ditch which have to be blasted out with the earth, heavier loading and proportionately greater cost ensues.



CROSS SECTIONS OF SMALL DITCHES SHOWING LOCATION OF CHARGES AND APPROXIMATE DIMENSIONS

U. S. GOVERNMENT TEST OF DITCH BLASTING

DITCHING FOUR RODS IN ONE SECOND

Drains 20 Acres in 10 Hours

E. I. du Pont de Nemours Powder Co.

Gentlemen—Through a piece of bog meadow we blasted some 500 feet of ditch in about 10 hours, 3 feet deep, 3 to 4 feet wide, which serves to drain some 20 acres. The use [illegible] Du Pont Straight 60 per cent. Dynamite placed in holes 2 feet apart and but 18 inches deep gave us the result. A greater depth than 18 inches gave us a deep hole but not as good result. We are using Du Pont Straight 60 per cent. Dynamite daily for various kinds of farm work with the use of a battery and several charges and have done excellent work.

Respectfully yours,

F. SCHROEDER.

Liked the Sample Ditch so Well Did More of It

Mr. A. L. Jones gave us a practical demonstration of the efficiency of your powder for ditching. I have adobe soil black and wet. We spent about an hour loading and punching holes 3 feet deep with 42 pounds Du Pont Straight 60 per cent. Dynamite, we opened a reasonably clean ditch 85 feet long, 6 feet wide on top and 3 feet deep.

Being pleased with the economy of it, I immediately placed an order with my dealer for more Du Pont Straight 60 per cent. with which to continue the work.

F. L. CHAMBERS,

Eugene, Oregon.

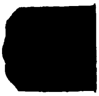
A FINE DITCH IN IDAHO

Herewith find photograph of a ditch made through brushy swamp land by using 1½ x 8 inch cartridges of Du Pont Straight 60 per cent. Dynamite, spacing the holes 20 inches apart. A passageway, wide enough for the person planting the powder, was made along the path of this ditch. The ditch averages 9 feet in width at the top and 4½ feet in depth and is very cleanly cut.

One part of it which does not appear in the picture was made through 24 inch thick, tough swampy sod. The sod was opened up and rolled back like a huge hide. After the shooting, the sides looked like two giant plow furrows of 5 feet width each one laid to each side.

LEWIS GRINDE,

St. Maries, Idaho.



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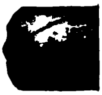

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TREE PLANTING

Professor Bailey's bulletin contains the following on orchard work:

"Success or failure date often from the day when the orchard is planted. Mistakes made then count ever afterward. The root system is fixed at that time once for all. The holes may seem deep and the furrows may be plowed deep, yet how shallow both are when compared with soils that have been blasted!

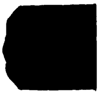
"The thorough preparation of the land is of the utmost importance in planting orchards and small fruit. Men are often in such a hurry to plant that they set out trees on ground unfitted by lack of tillage for their reception. Trees to do their best need to have the land in a high state of cultivation.

"The insect and disease resisting tree is simply one healthy and vigorous enough to resist their attacks. The ground must be so prepared that the growing trees may have plenty of room for their roots to extend into. They should go down as well as spreading out sidewise. If the roots are crumpled and confined, the tree is dwarfed. The holes commonly dug for trees may seem large, but they too often have hard walls and impervious bottoms. One might as well plant a tree in a tub of the same size as such holes.

"Trees often send their roots down twenty feet or more; compare this with the depth of ordinary plowing. If hardpan or rock is met by the roots they are forced to spread out laterally and become crowded and matted, or spread until they interfere with their neighbors and all are injured. This crowding of the roots means the dwarfing or stunting of the tree, less vigor to resist disease, and inability to stand a dry spell. Where trees are set shallow the roots are too close to the surface and suffer during a hot spell. The more porous and the looser the soil, the more rapid the growth of the tree, the deeper its root system, and the quicker it comes into bearing.

"By blasting, compact soils are made porous and converted into a sponge absorbing water and storing it for the use of the tree roots in the dry spell. Fire a charge of explosive deep down wherever a tree is to be planted. A shallow soil underlaid by a waterproof subsoil is worth little, for in the rainy season the tree roots are drowned or rotted, and in the dry season, the soil does not retain moisture and trees and fruits die rapidly.

"All fruit and ornamental trees should have the ground prepared first by blasting; then dig a hole and fill in alternately with soil and manure, or such patent plant foods as your fancy desires and your pocketbook permits. Where the orchard is growing, deep plowing by machinery cannot be done, but trees may be kept thrifty by small shots between the rows. Where the trees are quite old, start 6 or 8 feet away from the trees and put down the hole at an angle of 45 degrees, to a considerable depth and use a moderate charge according to the nature of the soil. The result will be seen in the second and third crop. It is good practice to use a small amount of explosives between the rows of trees every year or so. Never replant without blasting the ground."



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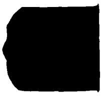

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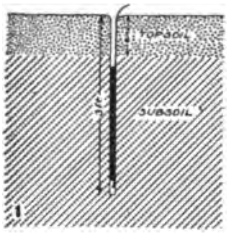
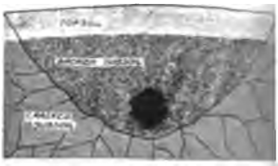


BORE HOLE
READY TO BLAST



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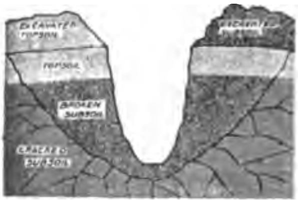
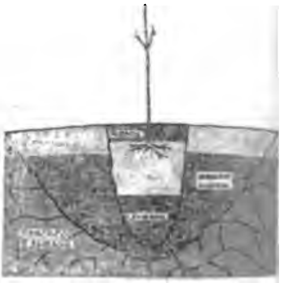


EXCAVATION TO
LOCATE POT HOLE



CORRECTLY
PLANTED TREE

The above diagrams illustrate the four chief steps in successful tree planting in blasted holes.

Du Pont Stumping Powder the "Only Thing"

This Spring I bought some of your Du Pont 20 per cent. powder for breaking up hardpan in my orchard, with th result it did it to my entire satisfaction. The trees on which I tried it were 4 years old, and show this year a much better growth than previous years.

In my estimation, powder is the only thing that will give trees subsoil drainage, and you have my permission to quote me to anyone asking information.

ULRICH C. JOHNSON,
Zillah, Wash.

Surface Dried by Blasting

This Spring I used in my orchard some of your Repauno Stumping Powder for subsoiling. I notice that after shooting, the surface was considerably drier than before, proving to me it did what I wanted it to do. Also, used the same powder with good success in blasting out some old apple trees.

FRED HAINES,
Zillah, Wash.

Proper Orchard Drainage Due to Blasting

As it is generally known, this section has considerable hardpan at various depths below the surface. In order to make good seepage, it is necessary to break up this hardpan, and in my estimation powder is the only thing that will do it. In fact, this Spring I used some of your Du Pont Stumping Powder with entirely satisfactory results. It is my intention to use more of it this coming Spring, both for breaking up hardpan and putting in a ditch on the lower side of my orchard. You have my permission to refer any others to me that are contemplating using powder for orchard work.

A. F. JAEGER,
Zillah, Wash.

Soil Takes Irrigation After Blasting

The results I secured from using Repauno Stumping Powder in our orchard were satisfactory. The orchard this powder was used in was an old one, and the soil gets parched and does not take the water well. I shot 400 shots approximately, using about ½ cartridge to a shot, and the result is that the soil took the water in good shape, which it would not do before it was subsoiled.

In my opinion powder is the only thing that will break the soil to a proper depth and I feel sure it is economical to use it.

M. CHRISTOPHER,
No. Yakima, Wash

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Crops Increased by Subsoiling

It gives me pleasure to advise that using Du Pont Stumping Powder for orchard work, has given me good satisfaction. This year is the first I have tried it, with the result that the soil takes water better than in previous years. Also, last year's crop of cherries was a good one, yet after the subsoiling my cherry orchard this year, I got 1½ tons more of cherries. Generally speaking, the results were fine, and I am satisfied powder will more than pay in orchards where the soil is tight.

H. R. HUMPHREY,
R. D. No. 4,
No. Yakima, Wash

Results Apparent to the Eyes

My experience with Du Pont Stumping Powder for orchard blasting makes me a strong advocate of its use. I have used approximately 400 pounds of your Du Pont Stumping Powder. The results I obtained are entirely satisfactory. The evidence is right before me, that the soil takes the water in better shape than it did before I broke up the tight soil that underlies my orchard, and aside from this the apples are a finer grade than they were before. Also, in my orchard I have planted alfalfa and its growth on the land which has been shot up is considerable in excess of that on which no powder has been used. Adjoining my orchard is one on which no powder has been used. This is planted in alfalfa between the trees, also, and the evidence is before anyone who wishes to look into the matter showing the superiority of land, that has had the tight soil broken with powder over that which has been merely scraped over with a plow. As is well known, a plow, and a deep soil one, at that, will just go so deep. There is no end to the depth that powder will go and which is only determined by the depth of the hole you put in and the charge of powder.

You have my permission to refer anyone to me who may be considering giving powder a try-out for the purposes I used it.

R. H. HOTCHKIN,
Wenatchee, Wash.

Blasting Results in Marked Improvement

I have pleasure in acknowledging your request for account of results after using your Repauno Stumping Powder in my orchard. I think the results well worth the labor and powder expended. Last fall I used enough powder to break up the hardpan around over 300 trees, and this fall intend using considerable more. This year I notice a marked improvement in the quality of the apples over that grown last year, and this in my estimation is proof conclusive as to the merit of using powder for breaking up the hardpan, which in places is too deep for a deep soil plow to reach.

Another feature is that the soil takes the water better after shooting.

H. D. JACKY,
Wenatchee, Wash.

Underground Effects Upon Roots of Trees Planted With Repauno Stumping Powder

Although Repauno Stumping Powder has been used for lasting holes in which to plant fruit trees as long ago as wenty years, it has only been within the last three years that he practice of blasting holes has become at all general. The ethod is now known and used in every State in the Union. It is enthusiastically recommended by horticulturists, nurserymen and fruit growers, who have tried it and who have arefully noted results.

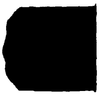
Many photographs showing comparative surface growth and development of trees planted in blasted and spade-dug holes have been published, but it was only very recently that any photographs could be shown of root development. It is an accepted fact horticulturally, that a tree's root system is practically commensurate with its above-ground limb and branch system. It is, therefore, of interest from a scientific standpoint to actually see the growth made by roots which have been assisted to penetrate the feeding bed by blasting the subsoil with Repauno Stumping Powder in comparison with the growth made by a young tree of the same age, in the same type of soil, planted in an adjoining plot in a spade-dug hole.

Figures 1, 2, 3 and 4, shown on page 21 provide such views. Figures 1 and 3 are views of trees planted in blasted holes; figures 2 and 4, of trees planted in spade-dug holes. It will be interesting to note the superior root development of the trees shown in figures 1 and 3. It will also be seen that the branch development of these trees is in proportion to the root growth.

The trees shown in figures 2 and 4 have much smaller root development and, as is to be expected, similarly small above-ground growth.

The reader's attention is specially called to the uniform growth or spread in every direction of the roots shown in figures 1 and 3. The soil, having been thoroughly pulverized and mellowed by the blasting, has enabled the roots of these trees to penetrate their feeding beds easily and evenly in all directions, thus not only securely anchoring the trees and protecting them against damage by high winds, out enabling them to reach plant foods in every direction from their trunks.

Observe the difference in figure 2. Here the roots are shown bunched and extending in one direction only. How much less securely anchored and how much more at the mercy of the winds is a tree with such root development; also how much more restricted is its feeding ground, the plant food in the soil on the sides of the tree not penetrate by its roots all practically going to waste.



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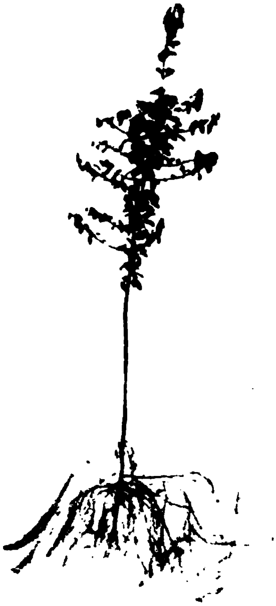


FIG. 1
PLANTED WITH REPAUNO STUMPING POWDER

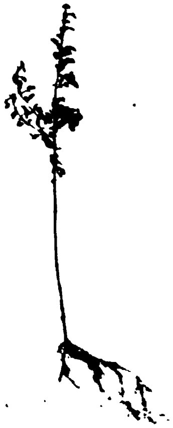


FIG. 2
PLANTED WITH SPADE
Same Time, Same Age, Same Orchard

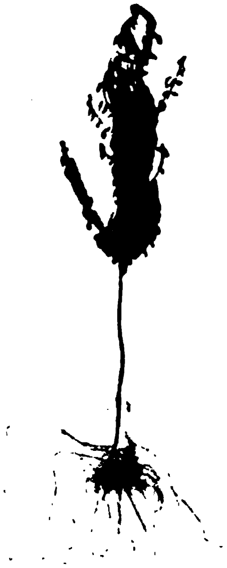


FIG. 3
PLANTED WITH REPAUNO STUMPING POWDER

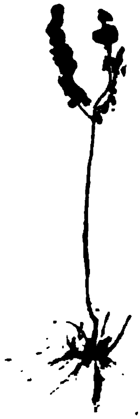


FIG. 4
PLANTED WITH SPADE
Same Time, Same Age, Same Orchard

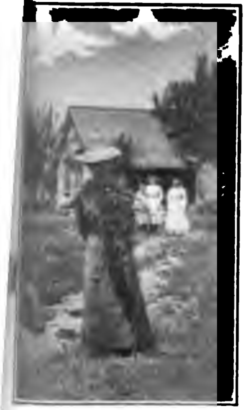


FIG. 1
TWO-YEAR-OLD APPLE TREE SET IN SPADED HOLE

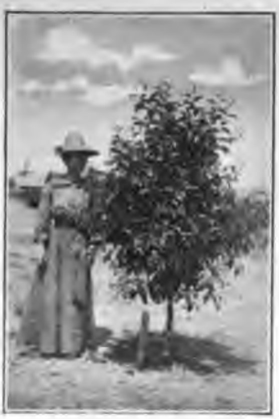


FIG. 2
TWO-YEAR-OLD APPLE TREE SET IN BLASTED HOLE

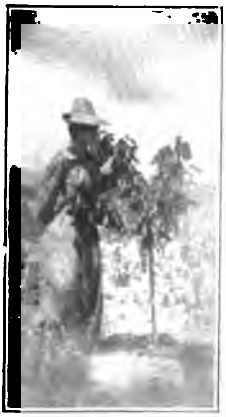


FIG. 3
BING CHERRY TREE, TWO YEARS OLD, SET IN SPADED HOLE

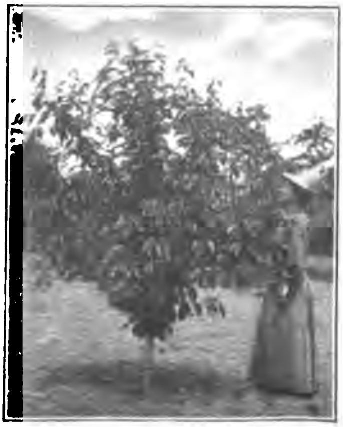
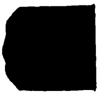


FIG. 4
BING CHERRY TREE, TWO YEARS OLD, SET IN BLASTED HOLE



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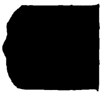

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Dynamite Tree Planting Shows Fine Resu

in Five Feet Oregon Loam

Gentlemen:—I am sending you photographs of four trees

Figures 1 and 2 are Bellflower apple trees; figure 1 was se in a spade-dug hole, and figure 2 in a dynamited hole.

Figures 3 and 4 are Bing cherry trees; figure 3 was set i a spade-dug hole, and figure 4 in a dynamited hole.

These four trees were part of a shipment of year old nursery stock received and set out the latter part of March, *1909*. The photographs were taken about the 15th of April, 1911, two years after setting out, just as they were coming *into* leaf.

Bellflower apple tree (figure 2) was pinched back in June, 1909, about ten weeks after planting. It was shortened in by removing some two feet of growth from each main lateral, the following November. In 1910 it had the same treatment. It is a very vigorous tree with healthy foliage and fine color.

Bellflower apple tree (figure 1) had as good ground to grow in, but was spade-set and made such small growth it needed neither pinching back nor pruning. Not a bit of growth, not a leaf has been removed from the head of this tree since planting. The trunk is less than half an inch in diameter, while the dynamite-set mate to it has several branches thicker and finer than the trunk of figure 2.

The Bing cherry trees (figures 3 and 4) have the same identical history as Bellflower apples (figures 1 and 2) with the exception that we did not shorten in at fall pruning (figure 4) as much as we did apple No. 3.

We have heavier tops and taller trees of these varieties in the orchard, but these trees are two favorites, very typical of their kind and strike a favorable average for the lot of five hundred. From 250 apple trees so set we got a perfect stand, not one died.

We use dynamite for making holes in planting trees on our very best and deepest ground, as well as the poor spots. It is much cheaper than hand labor, it is much quicker when speed is a most important point and delay will cause the loss of many trees. It insures every advantage to the tree getting a good start.

After the orchard is staked, one man with a shovel removes a circle of surface soil from about the stake, usually five cuts or so, which is laid to one side to use in filling the hole to proper level before setting the tree with the roots carefully pruned back.

A second man follows the first with a crowbar and works the hole down where the stake comes out. If a stone or anything of the sort is encountered we dig it out. If a spot of hard sediment or hardpan is encountered the hole is put through. These holes are about eighteen inches deep. We use one stick of dynamite properly fitted with 18 inches of best fuse for the average hole. It is dropped to the bottom of the hole and tamped down, then the fuse is lighted. There is very little stuff thrown up, the force going downward and outward. The holes are allowed to stand probably over night, or part of the next day, are probed with a crowbar, and, if satisfactory, the sides are broken in, the top earth at one side filled in, and the hole is ready for the tree.

We have set all our trees in wet weather, which insures a storage of moisture under the tree. If one were compelled to set in dry earth, a generous supply of water should be added to settle the hole prior to throwing on top earth that makes the bed for the tree to set on. Twice, each spring a circle should be worked up to a fine mulch about the depth of a spading fork, and kept loose, unbaked and free of weeds.

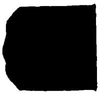
Last November we had occasion to remove some filler trees, Grimes Golden apples, seven months after setting out, one of which was spade-set. They were taken up with the greatest care so we could get the roots out intact just to prove to ourselves what difference in root growth we would find in same variety, in perfectly matched trees on the same ground from the two methods of setting.

The spade-set tree had a fine bushy and vigorous tassel of roots about a foot long. The dynamite-set tree had two roots going down some three feet. I held it out at arm's length, my hand clasped around the graft scar, and the roots touched the earth. Also it had a great quantity of medium and short growth roots. The difference was so convincing that we now have thirty acres of new orchard and every tree is set with dynamite.

You will probably be amused at my zeal, but I used half sticks of dynamite in making up a rose bed, and also for a hardy border set with peonies and other perennials. Am happy to say the peony plants are now ready to bloom profusely their first season, although, hitherto, I have failed to bloom them before the second or third year.

We wouldn't undertake to clear ground or set new trees, shade or orchard, without using dynamite, notwithstanding our soil is a beautiful loam, with little stone in it, and runs from five to six feet deep.

MRS. JOHN RAWLEY,
Grants Pass, Oregon.



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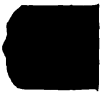

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VIEWS FROM ROGUELANDS ORCHARD

P. WELCH, President R. K. NEIL, Vice President J. T. SULLIVAN, Manager

ROGUE RIVER VALLEY CANAL COMPANY
AND
ROGUELANDS INCORPORATED

MEDFORD, OREGON

E. I. du Pont de Nemours Powder Co.,
Seattle, Wash.

Gentlemen:

In compliance with request of your Mr. R. A. Borst, we take pleasure in advising you as to the progress being made by our young orchards.

Since the Spring of 1911 this Company has set out about 44,000 fruit trees, mostly pears, all of which have been planted with dynamite. That is, several months before planting, in order to give the ground time to settle properly, we drill to a depth of about three feet through our close gravel subsoil and blow out the hole with a charge of your 40 per cent. Red Cross Extra Dynamite. This reduces the hard subsoil to loose gravel for a radius of from five to six feet around the hole and this area gradually increases, due to the action of water and air upon the shattered subsoil. The top soil is also loosened up so that deep plowing is easy from the start. The size of the charge depends upon the thickness and hardness of the subsoil to be blasted.

There is no doubt about the value of shooting in this manner. It supplies the tree roots with practically an unlimited field in which to spread out and down and also forms what may be termed "Soil Sponges," which absorb and retain great quantities of moisture, giving it up to the tree roots as required.

The photograph you have is of pear trees planted in March, 1912 and the photograph was taken September 20, 1913. The refills behind the first tree in the left foreground were planted last Spring and are, therefore, one year younger than the larger trees. Note the growth in that time. We do not believe that better trees, at their ages, can be found elsewhere in the valley. At least we have not been able to find any. This may sound like "enlargement of the ego," but several proud orchardists have already been convinced that their trees are no better than second to ours.

We hand you herewith another photograph taken on one of our tracts on September 20, 1913, showing apple trees planted in March, 1911. This tract is owned by Mr. Hugh Storey. The value of shooting is clearly demonstrated here. These trees are certainly making excellent growth and in addition, Mr. Storey's place has yielded fifty bushels of corn per acre from between the tree rows.

It has been proven in several of our local orchards that shooting has greatly benefited old trees and in our opinion shooting should be resorted to in a great many of the "Sticky Orchards" of the valley. The yields of some of these orchards should be increased at least 25 per cent. by blasting.

It would be well to place some of our orchardists on your mailing lists for publications bearing on this subject.

Yours very truly,
ROGUELANDS INCORPORATED,
J. T. Sullivan,
Manager.

VIEWS FROM LIBERTY ORCHARDS

LIBERTY ORCHARDS
GROWERS OF FINE ROGUE RIVER VALLEY FRUIT

Medford, Ore., Oct. 11, 1913.

Du Pont Powder Co.,
230 Stark Street, Portland, Ore.

Gentlemen:—You will be interested in knowing the results of experiments that we have made in "Plowing with Dynamite" for orchard cultivation. This was a departure in this valley from the old custom and its success justifies us in writing you so you may give the results to other people who may be equally benefited.

We found that after years of the old style cultivation there was a crust about a foot below the surface that was very hard to penetrate and under this crust rich, loose soil. The writer conceived the idea of boring holes some 24 inches deep and using your powder to break up the ground. The effect was, after using three-fourths of a stick of 20 per cent. powder, a hole about the size of a small tub. Instead of this hole being encrusted and the soil packed as some prophesied, we found it, while circular in shape, filled with cracks quite large and running laterally. The effect was that in the rainy season, although the holes more or less filled up with soil, the water made it so soft that to step into a hole meant to sink to the knee. These laterals acted as conductors of water, practically from tree to tree, and the result was all summer, not only was the ground loosened and the roots permitted to spread more freely, but the water was conducted along these cracks and the moisture conserved during the whole season. The holes were bored in the center of each square between four trees, and the result of this experiment was fruit not only more highly developed but more of it per tree than had been grown heretofore.

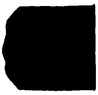
Any part of this letter that you may wish to use in the interest of orcharding, with which the writer is closely associated, will be free for your use.

Yours truly,
LIBERTY ORCHARDS,
By J. H. Neustadt, Owner.

Tight Orchard Soils Mellowed

Your representative has asked me for an expression of my opinion as to the results of your Repauno Stumping Powder for blasting tight soil in my orchard, and I have to advise that it did its work to my satsifaction, and to better explain, I might mention that last year I noticed that in certain spots in my orchard some of the trees did not turn out the crops they should have done. I tried digging around the trees, and found the soil very tight and hard, with the result that I tried out your powder and while just after shooting the soil, it showed no appreciable results, yet this year's crop leaves no doubt but that the powder has increased the yield considerably. You may quote me to anyone who may be considering using it.

R. BAILEY,
Wenatchee, Wash.



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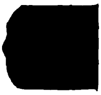

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VIEWS FROM ROGUELANDS—SPOKANE TRACT

TREES IN HUGH STORY'S ORCHARD

TWO YEAR OLD PEAR TREE IN WOODS BROS. ORCHARD
GRANT'S PASS, ORE.

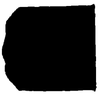
SUBSOILING WITH REPAUNO STUMPING POWDER

The following is taken from Prof. Bailey's Bulletin:

"The soil is the principal asset of the nation, the one that not only clothes and feeds us, but the one that will if properly cared for improve with age. It is a precious inheritance that should be jealously guarded and cared for, yet it is neglected, abused and misunderstood.

"Nearly all the best land of the country has been taken up and the question of the present and of the future is not one of greater acreage, but of greater production per acre.

"Explosives properly used in many ways and for many purposes mean less labor, less invested capital, less time, more acreage cultivated, and an increased production per acre.



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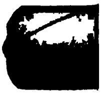

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"The use of explosives places in the hands of the farmer the means of maintaining and increasing the fertility of the soil, and in many cases to make soils productive that before were barren. An explosive is a labor-saving device that reduces the cost of production, increases the crop values, saves time and money, increases the acreage that can be tilled, increases the yield per acre, improves the physical character of the soil, and increases the value per acre of the land. Their broadest use and greatest value in agriculture will ever be for stirring, loosening, aerating and draining the soil, or in other words, DEEP PLOWING.

"Many seem to think of soils only as a mass of ground-up minerals and that when the valuable minerals are all dissolved the soil is worn out and exhausted unless mineral food is replaced by fertilizers. This is the old superficial view of soils that has led to endless errors, expense and loss.

"If the physical condition of the soil is good, crops will flourish. If the physical condition is bad, crops will not grow, no matter how much mineral fertilizer is fed to it. Barnyard fertilizers help mainly for the reason that they improve the physical condition of the soils.

"Minerals exist in nearly every soil in sufficient quantities to supply the plants with mineral food. One of the greatest steps in advance in agriculture in late years is the realization and recognition of the fact that practically all soils contain sufficient plant food for good crop yields and that this supply is indefinitely or permanently maintained and that the productiveness of a soil depends more upon its physical condition than it does upon its chemical composition.

"Normal soils, no matter whether they are the rich black loams of the Mississippi Valley or the sandy soils of the Pacific Coast, are really and finally nothing but mixtures of fine gravel, coarse sand, medium sand, fine sand, very fine sand, silt and clay.

"The importance of the soil particles in any soil mass lies in the total surface area of all the particles. The greater the surface area of the particles the greater the amount of water held as a film on their surfaces; or in other words the greater the amount of feeding ground presented for the hair-like rootlets to feed on. To appreciate what is meant by surface area, take this illustration: A rock 3 feet cube, or one cubic yard, exposes 9 square feet of surface on each of its six faces, or a total of 54 square feet. Divide it into 1 foot cubes, and the surface is increased to 162 square feet. Divide it into 1 inch cubes and it presents 1,944 square feet or nearly one-twentieth acre of feeding surface for the roots. But a single stick of explosive can easily convert several cubic yards of compact soil, or useless hardpan, into over half an acre of new feeding ground.

"By means of explosives larger pore spaces are created in the compacted soil and to depths greater than can be obtained by other means.

"Unless air freely enters the soil and is frequently changed nitrification cannot go on, hence the necessity of frequent plowing, raking, spading, and stirring the soil; but only an explosive can stir it to its depths.

"Soil atmosphere is of many times greater importance than the mineral contents of the soil. This is why deep aeration by explosives often gives remarkable results in the form of bumper crops, after expensive fertilizers have failed. An explosive thoroughly loosens the soil, admitting air and water vapor and the air is brought into direct contact with soil particles that had been previously shut away from it, giving a fresh supply of plant food. Many soils are extremely heavy, being composed of the fine particles of silt and clay. Such soils are easily puddled and compacted, becoming impervious to air and water, a condition easily changed by use of an explosive.

"The right amount of film water and water vapor and its maintenance by capillary water, united with air in the voids is the key to success in modern agriculture.

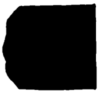
"Soils must be warm in order to produce crops. The essentials for good growth of crops are favorable light, air, warmth, and moisture conditions. A compact soil loses heat more rapidly than a loose one, and plowing with explosives warms the soil to a greater depth.

"Nearly all of the so-called worn-out soils are soils poisoned by prolonged production of one crop, or else they are soils in poor physical condition; abused and neglected soils. Nothing helps such soils as easily as the use of explosives to bring up fresh material from below and to admit air to oxidize the toxins into harmless material, or even into new plant food.

"Ground should be stirred and ventilated several feet in depth, something beyond the ability of the plow and only to be accomplished by the use of explosives.

"Most farmers know that our most important plants send their roots down not to 6 to 10 inches, but from 6 to 10 feet or more. The use of explosives alone solves this problem.

"The use of explosives is not simply a benefit in cases of hardpan, but is beneficial to all soils, and is necessary in any heavy, impervious soil. Its effect is to loosen, drain and aerate, and give additional feeding ground for the roots. It loosens up the structure of the deep material without bringing the subsoil to the surface. It fines the soil and increases the ease of root penetration. It establishes the best conditions for the storage of water, the rate and depth of percolation, increases the water capacity, and furnishes the growing plant with the right kind of water. It restores the so-called worn-out soils to fertility and makes otherv worthless acres produce record breaking crops."



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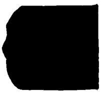

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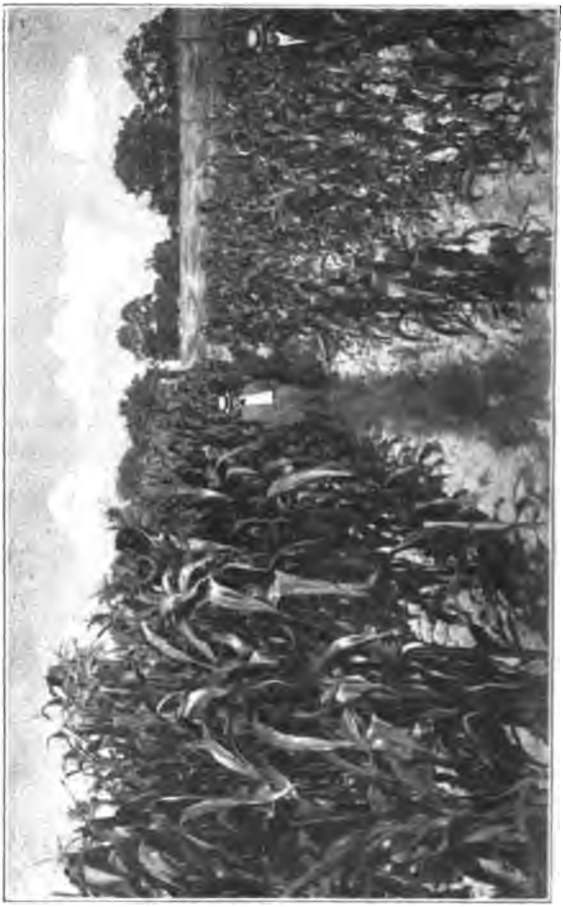

SMITH'S CORN SUBSOILED AND UNSUBSOILED

Under date of August 16, 1911, Mr. S. L. Smith, Superintendent of City Schools, Clarksville, Tenn., writes as follows regarding subsoiling with Repauno Stumping Powder:

"During December, 1910, I subsoiled one acre of ground on the Experiment Farm here which is run under the direction of the Agricultural Department of the joint High Schools, which ground before that time had produced nothing for several years. It was 'worn-out' land. This subsoiling cost about $12.00 per acre, but as compared with the excellent results obtained, I consider that it has paid us well.

"The corn shown on the left of the photograph which I sent you is on the blasted ground. That on the right of the same photograph represents corn planted and cultivated in the ordinary way without any scientific methods—no subsoiling. No fertilizer used on either the subsoiled or unsubsoiled ground, but well cultivated. Otherwise, the land not subsoiled was considered better than that subsoiled.

"Both acres were planted the same day and the subsoiled land will yield possibly three times as much as that not subsoiled. In fact, it is the best corn in the county, and all the farmers of the county who have seen it realize there is something in scientific farming. We selected the poorest land we could find, and it is my intention to subsoil more ground this fall."

PENNSYLVANIA DEPARTMENT OF AGRICULTURE

Division of Farmers' Institute, Harrisburg

West Chester, Pa., August 20, 1913.

. I. du Pont de Nemours Powder, Co., Wilmington, Del.

Gentlemen—It gives me pleasure to report to you that he experiment in subsoiling on my place, which was done little more than a year ago, has proved very satisfactory.

I had for several years been trying to get "a stand" of alfalfa on the field, but while I could get "a set" and once or twice a first cutting, I was unable in spite of my efforts to make the crop "stand" over a season.

I had tried all the methods of planting—liming—(ground limestone) inoculated soil, carefully selected seed and good cultivation, but to no avail, and in desperation last time I tried subsoiling—using one-half a stick of Stumping Powder every 15 feet at a depth of 3 feet. The result is apparent this year in a fine "stand" of alfalfa, from which in spite of the drought we have cut already two cuttings and expect to get another.

The alfalfa is luxuriant and strong and I believe the subsoiling and subsequent cultivation and care have at last secured me a permanent crop.

Thanking you for your interest and help, I am,

Yours truly,

JEAN KANE FOULKE.

SECOND YEAR RESULTS BETTER THAN FIRST

Anderson, S. C., September 23, 1912.

In reference to breaking land with Stumping Powder for farming purposes, will say that the land so broken in the spring of 1911 shows a greater improvement than it did the first year. The upland corn was at least 40 per cent. better than the corn raised on adjoining land that was not blasted. I blasted four acres this year and I find a great difference in the corn compared with the adjoining land. The greatest difference, as stated above, is the second year. I also broke some land for cotton late in the spring this year and I am much pleased with the results, as the cotton is still green and blooming and has stood the dry weather better than the other land.

Yours very truly,

J. S. FOWLER.

Under date of March 28, 1914, Mr. Fowler writes: "T ground dynamited a few years ago still shows good resu Altogether it has been quite a success for me."

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The larger book goes much more into details as to advantages of the methods herein recommended and explains clearly just how every kind of work should done economically, successfully and safely. Address

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COLUMBIA STATION, SEATTLE,
WASHINGTON, U. S. A.

Few Pointers
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A FEW POINTERS
ON
CHARGING and TAMPING
BORE HOLES

E. I. DU PONT DE NEMOURS POWDER CO.
ESTABLISHED 1802 WILMINGTON, DEL., U. S. A.

Introduction.

THE Du Pont Company has for years worked untiringly to persuade consumers of explosives to adopt only safe and sane methods in their use. At the same time, every effort has been made to educate the consumer as to exactly what practices could be considered safe and sane.

We do not feel that our efforts have been unavailing, but it is an undeniable fact that men are killed or injured almost daily, by accidents due to the improper use of explosives. It is also a fact that, because they are not using them as they should, many consumers are wasting a large percentage of the value of explosives, a matter which it might be supposed would interest the consumer more than the manufacturer.

However, we expect to keep on working for approved methods in connection with the use of explosives, and to that end, present this little booklet which expresses other people's ideas, as well as our own, on this topic.

E. I. du Pont de Nemours Powder Co.
Wilmington, Del.

February, 1911.

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Practical Experience in Charging and Tamping Bore Holes.

Reprinted from "FUEL," April 12th, 1910.
By Courtesy of "FUEL" Publishing Co.

The use and abuse of explosives is attracting as much attention if not more than any one subject now being considered by mining men, whether considered from the standpoint of the miner or the operator. Elaborate and costly experimental plants have been installed within a few years by the manufacturers of explosives and by the U. S. Geological Survey at the Pittsburgh Testing Station to determine the properties of the common explosives used in mining and to demonstrate the proper method of using them. The charging and tamping of the holes drilled to break down coal or rock in a mine are matters of interest and importance, but too often these operations are poorly done due to negligence, carelessness or inexperience. It is impossible to see inside a drill hole that has been charged to determine if the fuse has been broken or kinked, the blasting cap pulled out of the cartridge or to discover the other possible accidents that will

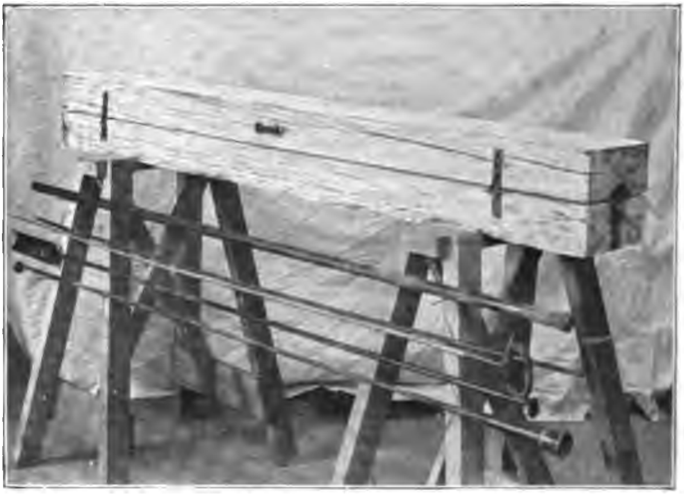

FIG. 1—CHARGING BOX CLOSED.

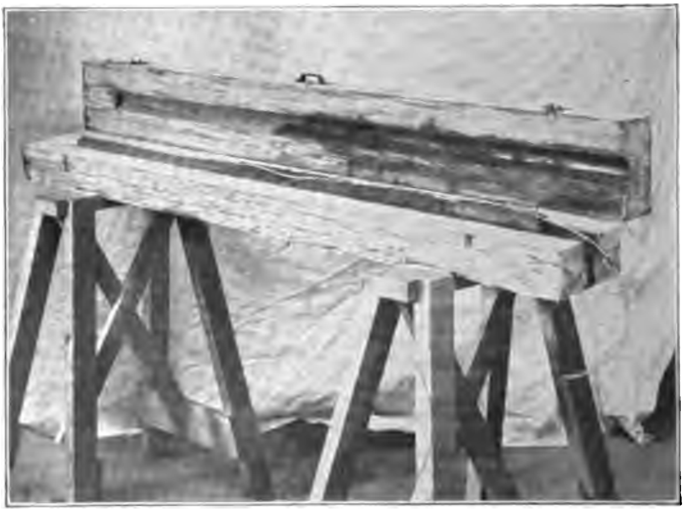

FIG. 2—CHARGING BOX OPEN.

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occur to every practical man. In order to enable the students in Mining Engineering at the University of Illinois to practice charging bore holes and then have the charge inspected and criticised, a charging box or "artificial hole" has been built. This is shown in the accompanying illustration and consists of a block of timber 8 in. square and 4 ft. 6 in. long, with a hole 2 in. in diam. drilled in the center. This block is sawed through the center, hinged and held firmly by clamps while the hole is being charged. It is then opened and the charge easily inspected. By varnishing and greasing the hole, the tamping is prevented from sticking to the wood when the top is raised. The "hole" is set on wooden horses and by raising one horse a bore hole inclined upward or downward can be obtained. Students are required to charge the hole, using different kinds of tamping, different explosives, and all of the ways of firing by squib, fuse and electric detonators. Sand or sawdust is used to represent black powder and dummy cartridges of inexplosive dope to represent the nitroglycerine explosives. The charge is examined and criticised by the class and by the instructor.

An experienced miner and former mine manager who was showing a class of students how to load the hole was very much surprised to find upon opening the box that the fuse was kinked into an S shape and broken.

By the use of this box, the effect of using different kinds of tamping can be easily shown, the rate of burning of fuse in a hole can be tested and other experiments with explosives demonstrated much better than in the darkness of a mine where also the inside of the charged hole can not be seen.

A glass tube was first thought of, but the glass breaks readily, is hard to clean from the tamping for another charge and moreover, as the inside can be seen during the tamping, the actual conditions are not represented nearly as well as with the block.

The blasting box or hole, which can be easily made and is inexpensive, is adapted for demonstrating to inexperienced men at a mine the proper method of charging. It can also be used for demonstration purposes before mining institutes, etc.

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Extracts from Bulletin 423 of the United States Bureau of Mines on Charging and Tamping Bore Holes.

"Confining an explosive is the cheapest and best way to use it."

"In blasting, any explosive gives the greatest disruptive effect when the charge most completely fills the bore hole from side to side."

"The cartridge should be gently pushed down into the bore hole by means of a wooden tamping stick. An iron tamping bar should never be used."

"When fuse is used it should be long enough to reach beyond the mouth of the bore hole. In some mines the practice has been to use but a short length of fuse and let the charge explode untamped or simply secured by running the tamping bar into the hole. This is a very bad and dangerous practice, and should be forbidden."

"Trouble happens if coal dust or any other dust is allowed to get between the cartridges in a charge. In loading, extreme care should be taken to make sure that the cartridges all touch one another closely. The hole should be tamped with clay or with other material that can not burn. It should never be tamped with coal dust (either wet or dry) or with machine cuttings known as 'bug dust.'"

"The pressure in tamping should be very gentle on the first tamping material put in, particularly if detonators are used in the primers, and great care should be taken at this time not to disturb the position of the detonator in the primer. Special care should be taken not to draw the detonator out from the primer or the fuse out from the detonator. When fuse is used, care should be taken not to rub the surface off of it."

"After the first six inches of tamping material has been pressed down, greater force may be used in ramming the rest, because the firmer the tamping is the better is the work of the explosive and the less is the chance of a blown-out shot. The tamping should be continued quite up to the mouth of the bore hole."

"It is not uncommon to hear the statement that high explosives, because they are quicker in action than low explosives, need not be tamped. This is a serious error. The fallacy of it has been repeatedly proved in the tests of many different explosives made at the Pittsburgh Testing Station. It has been clearly shown that the highest pressure an explosive can give, and therefore the greatest amount of energy it can set free, will be developed only when the explosive is confined in the smallest space."

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POINTERS.

CHARGING.

If water is running from the bore hole, load and fire as promptly as possible, and do not slit the cartridges unless Semi-gelatin, Gelatin Dynamite or Blasting Gelatin is used. If it is necessary to use Monobel in wet work, the bore hole should be swabbed out before loading and the cartridges should never be slit or broken.

A factor of great importance in the action of a charge of explosives is the "Air Space." High Explosives used in rock blasting should always be loaded compactly in the bore hole, so that no air space remains to act as a cushion when the charge is detonated, and so reduce its breaking and rending effect.

The best way to eliminate air spaces, is to use only dynamite cartridges which are just small enough in diameter, to permit pressing to the bottom or back of the bore hole without jamming. In addition to using cartridges of the right diameter, it is a good plan to slit the paper shells from end to end with a sharp knife, unless the work is wet. A cartridge of high explosives, only a little smaller in diameter than the bore hole, and with the shell slit, can be easily spread out with the tamping stick, so that it will entirely fill the section of even a somewhat irregular bore hole, and can be relied on to give maximum efficiency when detonated.

The above does not apply always in coal blasting where, under certain conditions, in the use of our Permissible Explosives, an "air shot" may give excellent results. In these shots, the air space between the charge and the tamping, with its cushion effect, results in a greater "spreading" of the pressure developed on detonation. These "air shots" sometimes break across the entire face when the same charge loaded without the air space will blow forward and bring down much less coal.

TAMPING.

Although High Explosives, particularly the higher grades, will give considerable local effect, even if fired with little or no confinement (as in "mud capping" rocks or boulders), they will not give anything like maximum results under such conditions, or even in bore holes that are not thoroughly tamped to the mouth or "collar." Therefore, the only economical way to use explosives, is to *entirely fill* the bore hole, after the charge is in place, with damp clay or similar material packed firmly into place. It is very dangerous to use metal rods, or sticks with any metal about them for tamping, and an all-wood tamping stick should always be provided for the purpose.

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Precautions to be Observed When Handling Explosives

DON’T explode a charge to chamber a bore hole and then immediately reload it, as the bore hole will be hot and the second charge may explode prematurely.

DON’T do tamping with iron or steel bars or tools. Use only a wooden tamping stick with no metal parts.

DON’T force a primer into a bore hole.

DON’T drill, bore or pick out a charge which has failed to explode. Drill and charge another bore hole at least two feet from the missed one.

DON’T use two kinds of explosives in the same bore hole except where one is used as a primer to detonate the other, as where dynamite is used to detonate Judson Powder. The quicker explosive may open cracks in the rocks and allow the slower to blow out through these cracks doing little or no work.

DON’T use frozen or chilled explosives. Most dynamite, except Red Cross, freezes at a temperature between 45° and 50° F.

DON’T cut or break a dynamite cartridge while it is frozen, and don’t rub a cartridge of dynamite in the hands to complete thawing.

DON'T allow thawed dynamite to remain exposed to low temperature before using it. If it freezes again before it is used it must be thawed again.

DON'T allow priming (the placing of a blasting cap or electric fuze in dynamite) to be done in a thawing house or magazine.

DON'T prime dynamite cartridges, or charge or connect bore holes for electric firing, during the immediate approach or the progress of a thunder storm.

DON'T attempt to take blasting caps from the box by inserting a wire, nail or other sharp instrument.

DON'T try to withdraw the wires from an electric fuze.

DON'T fasten a blasting cap to the fuse with the teeth or by flattening it with a knife—use a cap crimper.

DON'T attempt to use electric fuzes with the regular insulation in very wet work. For this purpose secure "Victor Water Proof" Electric Fuzes.

DON'T handle fuse carelessly in cold weather, for when cold it is stiff and breaks easily.

DON'T "lace" fuse through dynamite cartridges. This practice is frequently responsible for the burning of the charge.

DON'T cut the fuse short to save time. It is dangerous economy.

DON'T expect explosives to do good work if you try to explode them with a detonator weaker than a No. 6 (red label).

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